Industry & Power

A Petroleum Publication | "Executive Magazines for Industry"

JUNE 1956

For Men Who Manage

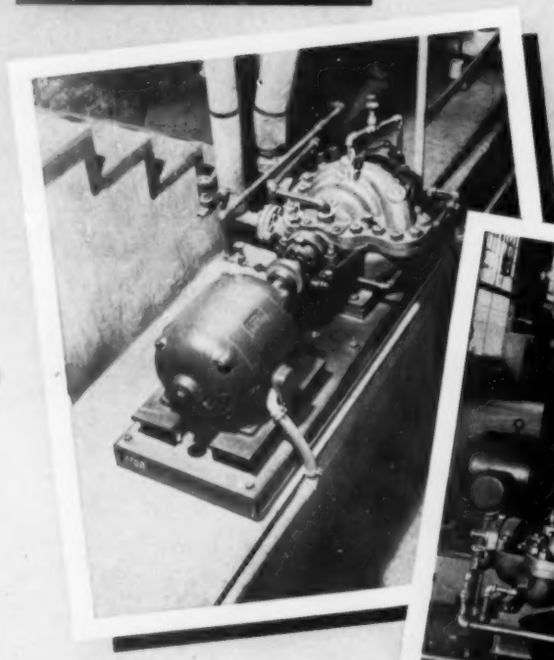
Power Services

PHILIP SPORN, American Gas and Electric Service Corporation.
Tomorrow's energy . . . where's it coming from? — see page 3

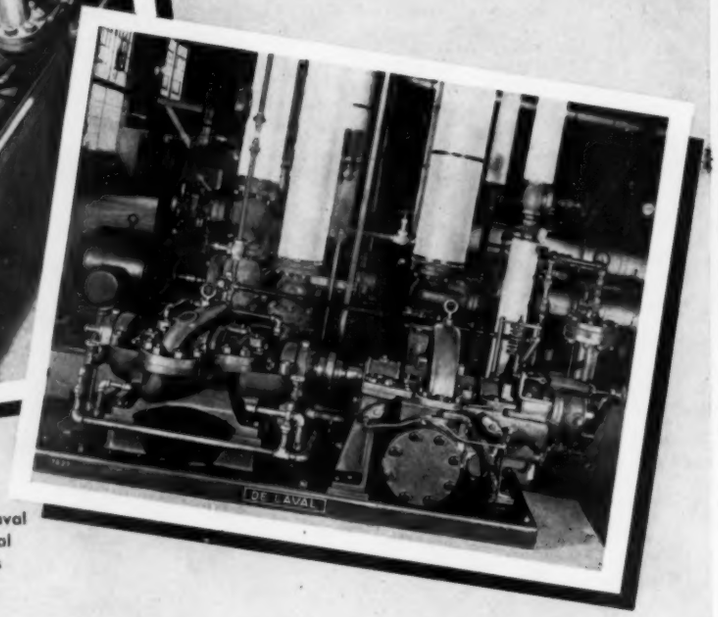
$1.00 the copy

DE LAVAL
TWO-STAGE
HORIZONTAL
PUMPS

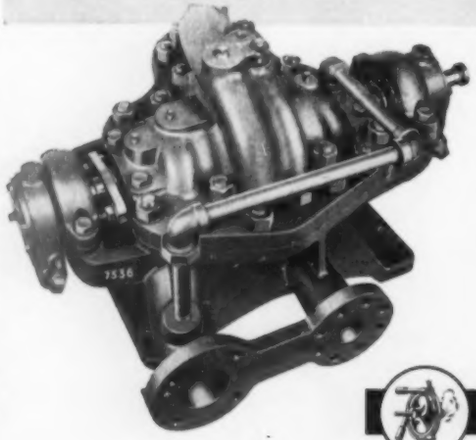
for dependable boiler feed service in institutions . . . industrial plants



Institutions can't afford shutdowns. In this hospital installation a motor-driven 21S boiler feed pump provides year-in, year-out dependability. It delivers 70 gpm of 240° water at 420 ft. head.



Industrial plants, too, choose reliable De Laval pumps for boiler feed service. This De Laval unit, driven by a De Laval turbine, delivers 160 gpm of 215° water at 520 ft. head.



There are good reasons why De Laval 21S-2KS two-stage horizontal split case pumps give long, economical boiler feed service. They are designed with • back-to-back impellers for balanced hydraulic thrust • easily replaceable threaded impeller wearing rings • long life labyrinth case rings • ring oiled ball bearings — plus ten other important design features.

These De Laval pumps are available in sizes from 2″ to 8″ discharge, for capacities from 75 to 3,000 gpm and heads to 750 ft.

Write for Bulletin 1501 giving complete data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
857 *Nottingham Way, Trenton 2, New Jersey*

DL 674

Circle 135 on READ-N-CIRCLE card for more data

late news

. . . about industry & power

● New look for water tank

Possibly you've seen this face before, right in your own newspaper—and here's why. It suddenly appeared about four months ago. Instantly, the once-ordinary tank that had received scant attention now caught the eye of the passer-by as well as that of the newspaper photographer.

Idea for the face was suggested by "some of the boys" at Putman Publishing Company who felt the tank needed something to relieve its prosiac appearance. The innovation has been variously described as the "Big Smile," "Laughing Water," and "Face Lift for a Water Tank."

● More lighting technicians required

An anticipated need for 3000 new technicians in the lighting industry in the next five years is predicted on the basis of a survey conducted by the Illuminating Engineering Society's Lighting Education Committee. About 900 new persons trained in illumination will be needed in the next five years in the area of light sources, lighting equipment, and accessories manufacturing. Another 600 trained people will be needed by the electric utility companies, approximately 600 more by architects and consulting engineers, 300 by electrical contractors, 300 by electrical wholesalers, and 300 by miscellaneous consumer organizations in closely allied enterprise.

● New cable eliminates pushbuttons

French cable factory has produced a conductor that will eliminate pushbuttons in many applications. New contact cable consists of two cotton-copper braids wound in spirals of the same direction and pitch, but shifted one-half pitch. Both braids are sewn on a rubberized linen strip wound edge-to-edge in a spiral, covered with rubber tape, then with a PVC sheath. A mere cross pressure with the hand on the cable brings

(more late news on page 4)

Industry & Power

For men who manage power services

ESTABLISHED MAY 1920

VOLUME 71 NO. 1 **JUNE 1956**

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INDUSTRY & POWER **forum**

Tomorrow's energy.... Where's it coming from?

PHILIP SPORN, President
American Gas and Electric Service Corp.

Fellow, AIEE and ASME

Former member, Electric Power Committee, National Security Resources Board

Former chairman, Committee on Cooperation between Electric Power Industry and AEC

Member, Visiting Committee, Nuclear Engineering and Reactor Depts., Brookhaven Natl. Labs.

OURS IS A technically advanced economy, which is another way of saying that it is a high-energy economy. We begin with total generation by utilities in the United States of nearly 550 billion kwh in 1955. I believe the corresponding figure for 1975 will be close to 2000 billion kwh. Industrial consumption will account for some 900 billion kwh of this, which excludes generation for self-use, of about 250 billion kwh. The 1975 worker will require tremendously more electric energy per hour of work. The 1953 figure of 9 kwh per manhour will, in my opinion, be nearly 19 kwh per manhour by 1975.

Installed hydroelectric generating capacity in the United States in 1955 was not quite 25 million kw or approximately 21 percent of a total generating capacity for the utilities of 114,550,000 kw. But the percentage of hydro power in the total of electric energy is on a declining trend. Hydro is bound to play a consistently diminishing role (it will contribute 12½ percent of 1975 generation) as power requirements continue to exceed the growth potential of hydro reserves. (Solar, tidal, and wind energy in the United States can be disregarded for the period in question.)

In view of the formidable technical-economic obstacles to be overcome, progress in making economically competitive nuclear installations is not going to be as dramatic as has generally been assumed. I am confident that the obstacles will be overcome, but only after some years of painstaking engineering development and experience. I do not believe that the total installed nuclear generating capacity by 1975 will reach a level much above 20 million kw in the United States. This will then represent some 5.2 percent of the total generating capacity at that time. Owing to high load factor, this capacity should account for approximately 150 billion kwh, or 7.5 percent of the total 1975 utility generated energy.

In 1955 natural gas supplied some 96 billion kwh, or 17.5 percent of the total electric energy, and 22 percent of the thermally generated energy of the United States. Conditions which have resulted in the continual rise—until reversed in 1955—in the production of electric energy by natural gas in the past two decades, and particularly since the end of World War II, are not likely to prevail over the next two decades.

My own judgment is that gas for utility generation in 1975 will be approximately 1.7 trillion cubic feet. This represents 200 billion kwh or 10 percent of total 1975 generation.

In 1955 oil accounted for 36 billion kwh, or 6.68 percent of the total generation and 8.3 percent of thermal generation. As in the case of natural gas, oil is being diverted to higher value uses for which economic or convenient substitutes are not available. Even residual oil itself is finding higher value uses in the making of petroleum coke, asphalt, and other materials. My own estimate of use of oil for power production in 1975 is 143 million barrels, or roughly 5 percent of the total.

In this country we are extremely fortunate in our coal reserves. To arrive at the portion of the electric energy to be generated by coal we are, therefore, able to simply subtract the percentages of the total requirements that will be supplied by hydro, nuclear fuel, gas, and oil. These are 12.5, 7.5, 10, and 5 percent, respectively. Thus, the total amount to be taken care of by coal is 65 percent, or 1300 billion kwh. This results in a 1975 coal utilization of 488 million tons.

There is on the horizon a young, vigorous, and serious competitor in the form of nuclear fuel but, considering the opportunities that are presented to coal and to the coal industry, I will not believe that the effect of the impending challenge of nuclear fuel will be anything but a stimulant to the industry. What is more important, all who will be meeting our energy needs will be making an immeasureable contribution to the welfare and safety of the people of the United States, and indeed of the whole western world.

From a speech delivered at the American Mining Congress, Cincinnati, Ohio, May 7, 1956

it's **boiler check-up** time!

HOW ARE YOUR BLOW-OFF VALVES?

Are they drop-tight? Rugged and dependable? Easy to maintain?

Just as important, do they have all the advantages and up-to-date improvements in materials and design of new YARWAY Blow-Off Valves?

Old YARWAY Blow-Off Valves also can be overhauled and modernized, because all YARWAY improvements are *interchangeable* with parts on earlier models.

Write today for free YARWAY Blow-Off Valve CHECK SHEET—also new YARWAY Blow-Off Valve Catalog B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

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Yarway Seatless valve for low and medium pressures. Features balanced nitralloy plunger that seals line drop tight—yet permits free, unobstructed flow in blow-down. **Used in over 15,000 boiler plants.**

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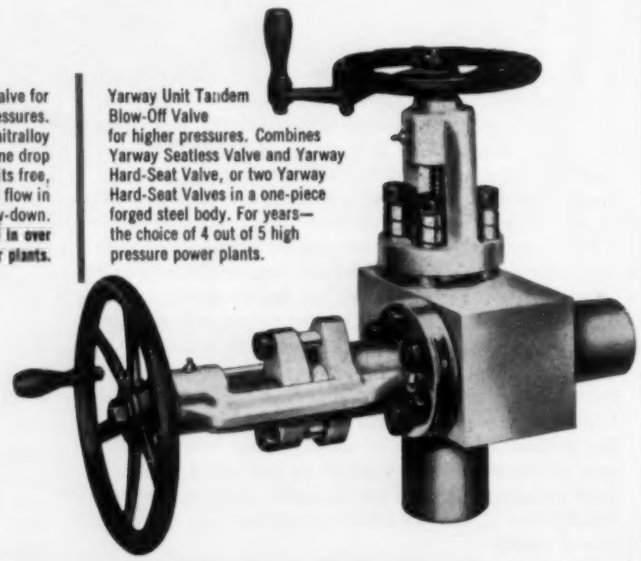

YARWAY blow-off valves

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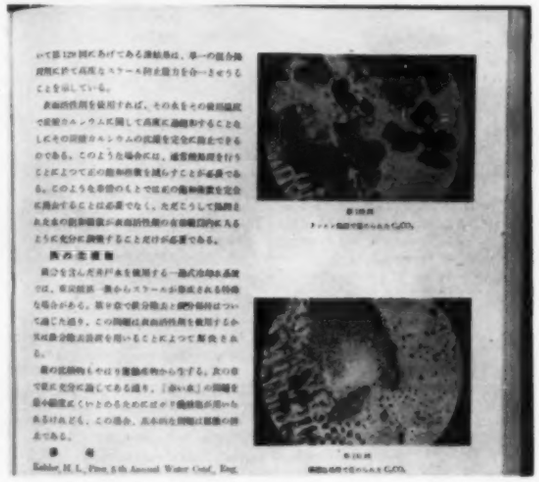
late news

. . . starts on page 2

the conductors into contact. New cables can be placed along the whole distance covered by operators when running machines. Cables should have many safety applications and solve several remote control problems.

● Japanese get water treatment story

Everyone has water problems, and the Japanese are no exception. So when sufficient demand had built up, W. H. & L. D. Betz found translation of their Industrial



Water Conditioning Handbook into Japanese was advisable. Net result is a most interesting-looking translation, perhaps the most unusual water treatment handbook around.

● York, Industrial join Borg-Warner

The board of directors of Borg-Warner Corp. and York Corp. have unanimously approved affiliation of the two companies. This affiliation is a part of Borg-Warner's planned program of diversification. When plan becomes effective, York will be operated as a separate division of Borg-Warner. York occupies a major position in air conditioning for industry, insituations and office buildings . . . Industrial Crane and Hoist has been acquired by Borg-Warner in an exchange of stock. Industrial makes cranes, hoists, trolleys, and monorail systems.

● More expansion at Indianapolis utility

Indianapolis Power & Light Company has retained Gibbs & Hill, Inc., New York consulting engineers, to design and supervise construction of a 105,000 kw extension to its Harding Street steam-electric generating station. Fifteen-million dollar expansion project is scheduled for completion in 1958. Total generating capacity then will be up to 265,000 kw.

A PUTMAN PUBLICATION

Industry & Power

For men who manage power services

VOLUME 71 NO. 1 JUNE 1956

In this issue . . .

advantages of centralized controls 12
Read what Corn Products thinks about its new centralized controls for three coal-fired boilers. One man supervises all boiler operations by watching a radial graphic panel.

competitive edge through cheaper power 14
Here's how KVP engineers investigated all the possibilities before they selected their new boiler to replace existing outmoded equipment. They found their answer in coal firing.

standard switchgear offers tailor-made job fast 18
How Bridgeport Brass got more room for future expansion by judicious use of modern compact switchgear. Find out how off-the-shelf units can give you a custom-built job.

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nuclear news

. . . about industry & power

PRIVATE CAPITAL FOOTS 80% OF THE BILL

Congress was told also, by its own Representative Sterling Cole: "I don't see how anybody, no matter how impatient he can be to get along with this program, can be critical of a situation in which it is apparent that $300 million worth of public and private capital is apparently ready to move into this brand new unexplored field, involving risks of varying proportions and of the $300 million apparently available, only a fifth is from public funds . . . . I take great encouragement from that situation." Representative Cole's $300 million figure covers the investment in 12 current projects to produce nuclear power.

SOCIETIES BREAK FRESH GROUND

Interest in nuclear energy and its effects on heating and air conditioning has produced a Nuclear Energy Engineering Committee within the American Society of Heating and Air-Conditioning Engineers . . . ASME and ASLE are planning a jointly sponsored lubrication conference that will give special attention to lubrication of nuclear power equipment. Eight papers are already lined up.

NUCLEAR POWER TO DOMINATE IN 25 YEARS

By 1980, when the growth curve of nuclear power development levels off, some 60 to 70 percent of new power plants then under construction will be nuclear. This was told by the AEC to the Joint Congressional Committee during recent hearings. AEC's guesstimates ran like this: "The growth curve [estimated percentage of new capacity to be placed in operation] can be divided into three phases. The first phase, the one we are in now, is primarily research and development in order to achieve the basis for economic nuclear power. At some point in time, the degree of confidence in the eventual economic advantages of nuclear power will become so strong that a relatively large proportion of new power plants will be nuclear. When this second phase is reached, it is not difficult to foresee the proportion of nuclear power plants to the total number being built increasing from perhaps 5 per-

TYPICAL OPERATIONAL CHARACTERISTIC CURVE FOR THE "CORDON" CIRCUIT BREAKER

HOW IT WORKS: Combining and coordinating standard circuit breaker characteristics with specially designed current limiting Amp-traps, the "Cordon" circuit breaker achieves the characteristics shown above.

The thermal-magnetic overcurrent devices provide coordinated protection against overloads and short circuits up to a predetermined value (crossover point). At this point the current limiting Amp-traps assume the fault-clearing duty and extend short circuit protection to 100,000 rms amperes.

Unless the magnitude of a short circuit reaches the crossover point, the Amp-traps are unaffected, and the standard circuit breaker overcurrent devices perform their normal function. Since the fast clearing time of the Amp-trap (less than ½ cycle) provides current limiting, the magnetic and thermal stresses, which are proportional to the square of the current, are greatly reduced. Consequently, the standard molded case type circuit breaker safely withstands the heavy fault current. It is unnecessary to design bus-supporting members or current-carrying parts to meet the maximum peak current.

The Amp-traps are mounted in a molded housing which plugs into the load side of the breaker, forming one compact unit. A design feature of the "Cordon" circuit breaker actuates a common tripper bar when any Amp-trap blows, opening all poles of the circuit breaker. Until the blown Amp-trap is replaced the circuit breaker cannot be closed. A mechanical linkage arrangement automatically opens the circuit breaker before the Amp-trap housing is removed.

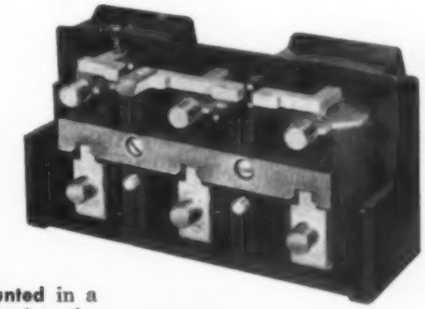
New I-T-E "CORDON" Circuit Breaker

100,000 amp interrupting rating in molded case circuit breakers

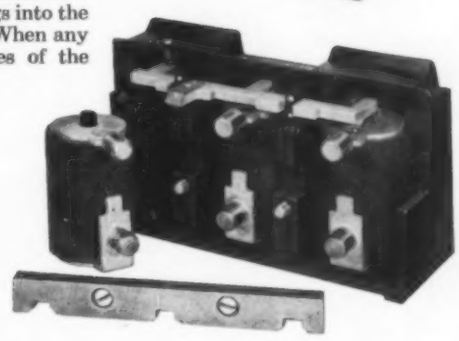
Now—one compact circuit breaker provides the practical, economical solution to meet constantly increasing interrupting requirements. The new "Cordon" circuit breaker provides all of the design and operating advantages of the famed I-T-E molded case breaker, plus interrupting ability up to 100,000 rms amperes.

The "Cordon" circuit breaker can be utilized in normal branch and feeder circuit applications in switchboards, panelboards, load centers, and individual enclosures. Plug-in mounting, rear connected studs, or front connected terminal mounting arrangements are optional.

"Cordon" circuit breakers are available with 2 or 3-pole construction in 100, 225, 400 and 600 ampere frame sizes, 250 v d-c and 600 v a-c. Write for complete details or call your nearest I-T-E office. I-T-E Circuit Breaker Company, Small Air Circuit Breaker Division, 19th & Hamilton Sts., Phila. 30, Pa.



The Amp-traps are mounted in a molded housing which plugs into the load side of the breaker. When any Amp-trap blows, all poles of the breaker are opened.



Draw-out design feature of Amp-trap housing provides accessibility to simplify change of Amp-trap. Amp-trap stud design assures proper alignment and positive connection when inserted in the breaker frame.

To replace a blown Amp-trap (indicated by released plunger), simply loosen two screws, remove the retaining bar, withdraw the blown unit, insert the new one, and replace the retaining bar.

I-T-E CIRCUIT BREAKER COMPANY

Small Air Circuit Breaker Division

Circle 113 on READ-N-CIRCLE card for more data

cent to perhaps something like 60 percent in 10 years or less. In the third phase, when the proportion of new nuclear plants reaches about 60 to 70 percent, the growth may level off. At that point, the rest of new capacity will be in hydroplants, very small plants, or in plants located where conventional fuel costs are exceptionally low."

NEW APPROACH: ORGANIC MODERATOR

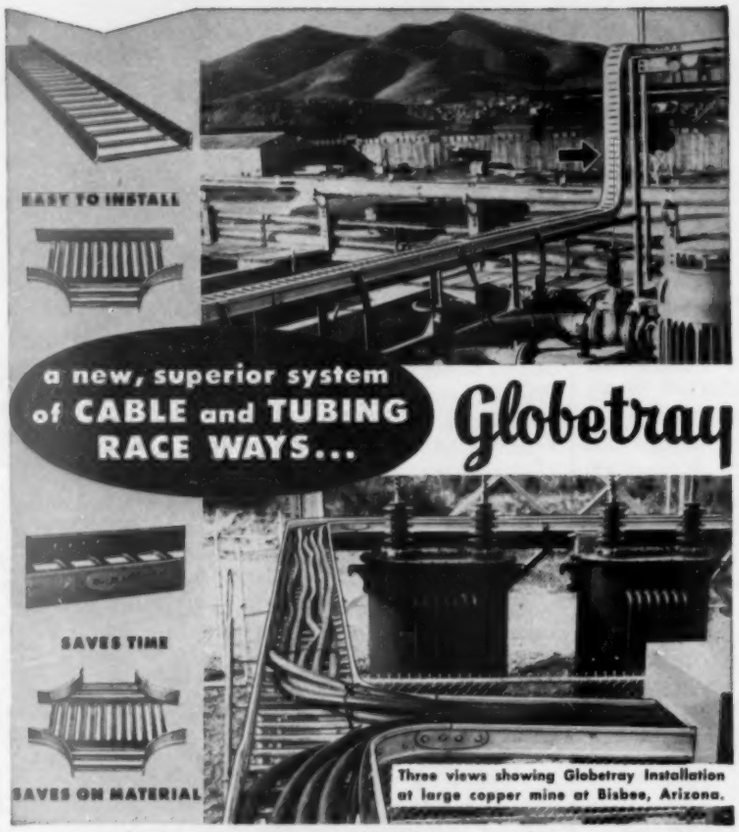
Technical feasibility of using hydrocarbon diphenyl as a reactor moderating and cooling material will be investigated under terms of a new contract between the AEC and Atomics International Division of North American Aviation, Inc. Some $1.8 million will be spent, almost half by Atomics International itself, to confirm expected advantages of low induced radioactivity, low corrosion of fuel elements, and high boiling point which makes reasonably high-temperature systems possible.

MORE NUCLEAR POWER PLANTS APPROVED

Rural Cooperative Power Association of Elk River, Minn. has received a go-ahead from the AEC for further negotiation on a closed cycle boiling water reactor plant with electric capacity of 22,000 kw . . . . Wolverine Electric Cooperative of Big Rapids, Michigan has received similar blessing for further negotiation of an aqueous homogeneous reactor plant in the range of 5000 to 10,000 kw electric capacity . . . . Five other proposals, made in response to the AEC's second invitation under its power demonstration reactor program for plants in the 5000 to 40,000 kw range, are still being evaluated.

MANPOWER STILL A PROBLEM

Congress was told, further, that the current shortage of technical people has further ramification in nuclear energy because "First, it [nuclear engineering] is a new subject in contrast to the courses of physics and chemistry which underlie this field. Engineering courses in atomic power and atomic energy in general are new . . . . The second point is that the engineering schools need on their own campuses some rather specific types of nuclear equipment and apparatus which they do not now have in general."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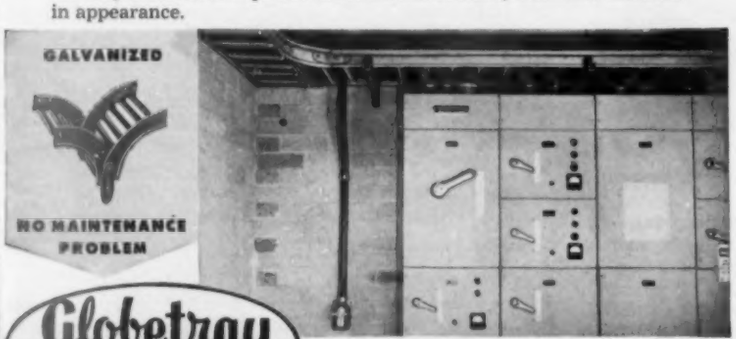
a new, superior system of CABLE and TUBING RACE WAYS...
Globetray
SAVES TIME
SAVES ON MATERIAL
Three views showing Globetray installation at large copper mine at Bisbee, Arizona.

A completely engineered system of cable ways, production produced and die formed for uniformity with up to twice the strength of ordinary trays, by actual laboratory tests. The universal splice plate joins all parts through the side channels only. All curved fittings are joined at the end of the radius (no tangent material is required) permitting continuous curves. This feature provides greater flexibility of application in tight places and creates an endless variety of combinations for a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings.

Comes in 6", 12", 18" and 24" widths, in standard 12' lengths to further speed up installation time. Cable way can be cut to length at any point – insides and bottom always smooth – all sections punched for easy installation – perfect fit at all times. Neat, clean and uniform in appearance.



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our readers write

. . . to industry & power

Old-timers, you are underpaid

Gentlemen:

This editorial [this month's comment, p. 33, April INDUSTRY & POWER] is an illustration of how a sound premise can be used falsely. "We waste most what we need most," with reference to young engineers, is a sound dogma; but to use this to crab about the money the young people are getting as starting salaries. [*sic*]

Such remarks as, "And these green grads will start their professional careers at anywhere from $400 to $500 per month" and "It takes several years for any engineer to be trained by his company to the point where he begins to earn every dollar he's paid" present insinuations that are truly false.

In the first place, back in our twenties, engineers were hired at an average of $150 to $250 a month, right out of college. Isn't it reasonable to expect $350 to $500 to be a proper figure in view of inflated values. In this same vein, I'll venture to state that the ratio of the salary of the young engineer to that of the electrician who works in the shop that prints your magazine is about the same today that it was in the twenties.

The trouble, today, is that the old engineers with 15 to 20 years' service, who have been happy with $7500 a year, find the younger men are coming into the organization at $5000 a year. The older men are worth more than $7500, but they have homes and friends and are secretly afraid they cannot hold a new job, so they squeal at the new state of affairs. They have traded salary for security; they have probably traded salary for a bit of routine, too; and they have probably also traded engineering for something or other—perhaps for an editorship: and their souls rebel at the adventurous.

But, your premise is right, "We waste most what we need most." Let's put our engineers to work! Let's arrange a schedule so that they can be put into creative work as quickly as we can train a lathe hand. But let's not say that a young engineer cannot earn a salary sufficient to start a home—and you know he can't do that well even at $5000. Let's, instead, sell the manufacturers on a program whereby they can start them at $5000 and get to $10,000 in, say, 5 years. Such a program could be worked out in every plant, if the young engineer wasn't doped into a sound sleep when he got his first job.

W. W. Mattson
2712 Roosevelt
Middletown, Ohio

• *Who said editorships are not adventurous?*

Here's your package deal

Gentlemen:

In your April, 1956 issue in the "our readers write" column you published a letter from Mr. Sigman Gendein of the Corps of Engineers, Detroit, requesting data on "Package Waste Treatment."

In your note you expressed interest in the extent of the package idea in industrial waste treatment and requested hearing from your readers on the subject.

I recall the "Special Report on Industrial Waste Treatment" that you published several years ago.

Since that time our firm here . . . set up in October, 1954 a special division—Industrial Wastes Division—headed by the writer, for just this purpose of providing for industries faced with industrial waste problems a package deal to solve the problem, design and build the plant.

The basis for this organization was my belief, from long association with industrial waste problems with the Dorr Company, that industrial plant officials would welcome an organization that would take industrial waste problems off their hands and solve them in a practical and economical basis, delivering to them a completed, working entity, all in one package.

*"You mean **all** you have to do all day is keep your eye on a few meters while I slave at home watching **your** kids!"*

Thus we organized our division on the basis of 1) studying a problem; 2) making necessary field and laboratory tests; 3) designing the plant; 4) furnishing and installing all equipment; 5) complete construction; and 6) instruction and supervision of operation.

As we do not manufacture or represent any equipment, apparatus, etc., nor propagandize any specific type or method of treatment, we are free and uninhibited so as to be able to work out for each client the most practical and economical plant for his specific use, regardless of the equipment or apparatus indicated.

Although we established this division only a little over a year ago, the result has been very encouraging, indicating that the idea is basically sound, as we have performed in one or other variations of our plan for a number of clients, including several of the largest manufacturing concerns in the United States.

We trust that this information will show you that the "package idea" as we conceive it, is a practical working plan.

E. B. Besselievre
Manager, Industrial Wastes Division
K & H Engineering Company
Toledo, Ohio

● *Seems as though the package concept in power services equipment is not only here to stay, but as yet knows no bounds.*

---

send in your

cartoon ideas

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H. A. Bergen, Editor
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Industry & Power

For men who manage power services

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Industry & Power • FOR MEN WHO MANAGE POWER SERVICES

ESTABLISHED MAY 1920

this month's comment . . . .

Please . . . . take a second look

. . . for, as you've noticed, this issue of INDUSTRY & POWER wears a new dress . . . . a larger, different format.

Look again, please, at the front cover . . . . at the large picture of Forum commentator Philip Sporn, with the artist's suggestions of his subject . . . . fossil fuels, hydroelectric power, and nuclear energy.

Turn to pages 12, 14, 16, and 18. Note the dramatic "cinemascopic, wide-screen" effect. Observe how much more you actually *see* in these big pictures and charts. Here you see things more nearly as the human eye sees things in everyday life . . . . wide vision on either side, not up-and-down. And BIG.

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Russell L. Putman

Russell L. Putman, President
PUTMAN PUBLISHING COMPANY

P. S. INDUSTRY & POWER is "different" in other ways too. For example . . . . in giving you its editorial service without demanding a formal subscription price. Why? Let's talk about that in a later issue.

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When does your present equipment
become outmoded beyond the point of economic usefulness?
Read how Corn Products Refining found its answers in its . . . .

Switch to *CENTRALIZED CONTROL*

DON HAGEN
Superintendent of Steam and Power
Corn Products Refining Company
Argo, Illinois

Diamond automatic sootblowers are used once or twice a day, depending on age and condition of boiler.

WHEN DO YOU justify discarding old, but operating, equipment in favor of something new? Power services engineers at Corn Products Refining had to choose between discarding two sets of local boiler controls in favor of centralized controls or continuing with the existing equipment at their Argo, Illinois, plant. They decided to put in centralized control. This decision has been fully justified after 18 months' operation. Centralized controls are saving labor, building costs, and operator training costs. Most important, however, is improved operator morale and on-the-job self-confidence.

In 1949, two 250,000 lb/hr pulverized-feed boilers operating at 650 psig and 750 F were installed. These two boilers had local control panels and gage boards that were set up front to front. Operators couldn't watch both panels simultaneously. When a third high-pressure boiler was considered, centralized controls came up for consideration.

Management realized from experience with process control centers that graphic representation of the process and logical instrument arrangement in the control center was extremely desirable in emergencies—even to the most experienced operators.

Operating personnel were brought into the discussions at an early stage. All agreed that these features were required:

- Indication of necessary information so that operator can see at a glance significant conditions existing at each boiler.
- Indication of trend information for operator to use when operating manually.
- Logical arrangement of controls to reduce possibility of mistakes.
- Indication of sufficient extra information for operator to make adjustments for better efficiency.
- Intercommunication between central operator, foreman, and assistant boiler operator.
- Maintenance facilities to allow quick diagnosis of instrument troubles and simplify repairs.

Logical grouping developed in discussion of the necessary instruments for the control center. First group consists of those instruments that must be within the operator's reach at all times. These are on consoles. Second group consists of instruments that must be constantly in operator's view. These are on a graphic panel. Third group consists of those instruments that need not be manipulated or constantly supervised by operator, such as soot blower controls plus various integrators and recorders for keeping operating records.

Centralized controls now enable one man to supervise all three coal-fired boilers with ease.

planned for expansion

Long-range plans for steam generation pointed to six high-pressure boilers, so the central control station was planned with this in mind. Control room was built, therefore, at the new end of the existing powerhouse. When all six boilers are installed, control room will be centrally located.

Control room is outside the powerhouse proper to avoid noise and vibration. Wisdom of this construction is borne out by the almost-complete absence of vibration and noise, although the walls were given no acoustic treatment. A huge picture window in the wall between control room and powerhouse prevents feelings of claustrophobia in the operators.

Each boiler has a 30-degree segment of the radial-type graphic panel. Space between segments for No. 3 and No. 4 (proposed) boilers holds instruments for auxiliary equipment common to all boilers.

A boiler cross section displays instruments that must be constantly viewed. Panel symbols for the boilers are based on scale drawings of the boiler cross section, supplied by the boiler manufacturer. With the exception of some artistic license in showing a single-drum installation, equipment is arranged as it actually exists in the powerhouse.

Graphic symbols are used wherever possible. Rotameter symbols, for instance, show flow rates of coal, air, steam, and water. Back-lighted symbols show equipment in operation. Indicator board color scheme is arranged for instant recognition to minimize fatigue in operators.

arrangement simplifies identification

Instruments on control consoles are arranged to simplify association with indicating instruments on graphic panel. Three pulverizer control stations are at the leading edge of the consoles, arranged in the same order as the symbols on the graphic panel. Electric switches for pulverizers and coal feeders are located directly above the corresponding control stations. Consoles also carry controls for forced draft fans, feedwater valves, and induced draft fans.

Three dual-trend recorders are located in the sloping section of the console for use during manual operation. These recorders show steam flow, air flow, feedwater flow, drum level, steam pressure, and feedwater pressure. Fuel-air ratio control is at the left of these recorders and the interlock switches are to the right.

Backlighted nameplates for the annunciator signal system are in the sloping section of the operator's desk. Control switches for booster pumps, the one motor-driven feed pump, and ignition oil pumps are in the space next to the annunciator.

Master control for the intercom system is in the

(continues on page 24.)

How thorough designing by staff engineers produced powerhouse modernization program giving Kalamazoo Vegetable Parchment a . . . .

COMPETITIVE EDGE through CHEAPER POWER

F. TERBURGH
Chief Engineer

R. M. CHERMAK
Assistant Chief Engineer

E. A. WADE
Project Engineer

As told to R. W. DE MOSS
Assistant Editor

BECAUSE YOUR staff engineers know your power problems first-hand, you might find—as Kalamazoo Vegetable Parchment Company did—that you can solve your own power engineering problems best. KVP staff engineers correlated all possible solutions of their steam power problems into a set of easily compared cases (see Fig. 1, overleaf). Figures were confirmed by an outside consulting engineer. Result: KVP designed its own power services improvement program, parlaying day-to-day operating experience into top-notch design.

KVP was faced with increasing its boiler and electric generating capacity due to increased production. KVP wanted to halt increasing costs of maintaining outmoded equipment. Records maintained over the past 10 years showed that power requirements were keeping pace with previously estimated increases of 5 percent per year.

Large demands for power and electricity are involved in all paper-making processes. Cost figures indicate that power contributes 11 percent of the manufacturing costs. With power accounting for such a large percentage of production cost the paper mill with the least expensive power has a decided marketing advantage.

Preliminary investigations were started in 1952, when it became apparent that additional steam and electric power were needed for KVP operations in Kalamazoo. Existing installation consisted of eight boilers operating at 220 psig and having a maximum combined steam output of 350,000 lb/hr (Case 1, Fig. 1). Purchased power amounted to 30 to 40 percent of total electric power cost.

E. A. Wade (extreme left), and D. E. Yost, KVP engineers, inspect magnetic iron removal equipment.

Replacement or reconditioning of the older equipment would alleviate maintenance problems of plant old age, but would contribute little to the reduction of operating cost. A detailed engineering study was initiated with these objectives:

- Keeping capital investment minimum
- Considering all possible fuels
- Considering operating cost
- Considering maintenance cost.

Economic evaluations of bids were made for all principal equipment items. Bid with the lowest initial equipment cost or highest efficiency did not necessarily show best return on investment. Capital investment was held to a minimum by eliminating luxury items, particularly unnecessary automatic devices. While they relieve the operator of minor manual duties, they rarely show a return on investment and require considerable maintenance.

Heat balances were developed considering coal- and oil-fired boilers as well as gas turbines. Boiler operating steam pressures of 220, 600, 850, and 1250 psig were considered (Fig. 1).

Initial cost estimates quickly ruled out oil firing. Transportation and handling costs, even with large volume purchases, pegged the price of bunker C at 8.502 ¢/gal. Based on cost to obtain an assumed 200,000 Btu/hr with 100-percent efficiency, and the following data:

Oil: 155,000 Btu/gal @ 8.502 ¢/gal
Coal: 12,500 Btu/lb @ 0.45 ¢/lb ($9.00/ton)
KVP found fuel costs to be:

$$\text{Oil: } \frac{200{,}000 \text{ Btu/hr}}{155{,}000 \text{ Btu/gal}} = 1.29 \text{ gal/hr @ } 8.502 \text{ ¢/gal}$$
$$= 11 \text{ ¢/hr}$$

$$\text{Coal: } \frac{200{,}000 \text{ Btu/hr}}{12{,}500 \text{ Btu/lb}} = 16 \text{ lb/hr ¢ } 0.45 \text{ ¢/lb}$$
$$= 7.2 \text{ ¢/hr}$$

CASE	PLAN FOR POWER PLANT OPERATION		ELECTRIC POWER DEMAND (PEAK VALUES KW)			STEAM DEMAND (PEAK VALUES LB/HR.)			PER CENT CONDENSING STEAM	PLANT EFF	COAL BURNED TONS PER HOUR	YEARLY AVERAGE COAL BURNED TONS/HR 90% OF PEAK	YEARLY AVERAGE COAL COST/HR 90% OF PEAK	COAL COST PER YEAR 7500 HR	LABOR MAINT & FIXED COST PER YEAR	PURCHASED POWER COST PER YEAR	TOTAL OPERATING COST PER YEAR	TOTAL INSTALLED COST OF NEW EQUIPM'T	ANNUAL SAVING WITH NEW EQUIPM'T
			PURCHASED	GENERATED	TOTAL	PROCESS	CONDENSING	TOTAL											
1	OPERATION FOR 1954	WINTER	3,500	10,500	14,000	228,000	63,000	288,000	21.9	55.8	16.2	13.36	120.00	900,000	475,000	236,000	1,611,000	0	0
		SUMMER	3,500	10,500	14,000	150,000	90,000	240,000	37.5	46.8	13.5								
2	OPERATION FOR 1956 PURCHASE - 1 NEW BOILER 220 LB 175,000 #/HR CONTINUE TO PURCHASE ELECTRIC POWER	WINTER	5,400	10,000	15,400	242,000	84,000	326,500	25.7	53.0	18.0	14.1	127.00	953,000	500,000	364,000	1,817,000	605,000	0
		SUMMER	5,400	10,000	15,400	161,500	88,500	250,000	35.4	49.8	13.3								
3	OPERATION FOR 1956 PURCHASE - 1 NEW BOILER 175,000 #/HR 220 LB 1 NEW TURBINE 220 LB EXTRACTION CON. 7500 KW	WINTER	0	15,400	15,400	242,500	135,000	377,500	35.8	50.2	20.5	17.0	153.00	1,148,000	500,000	0	1,648,000	1,163,000	169,000
		SUMMER	0	15,400	15,400	161,500	160,500	322,000	50.0	42.5	17.4								
4	OPERATION FOR 1956 PURCHASE - 1 BOILER 850# 175,000 #/HR. 2 TURBINES 7500 KW EACH 1 EXHAUST - EXTRACTION 1 EXTRACTION - CONDENSING	WINTER	0	15,400	15,400	242,500	82,000	324,500	25.2	56.0	18.4	15.0	135.00	1,013,000	500,000	0	1,513,000	2,017,000	304,000
		SUMMER	0	15,400	15,400	161,500	102,000	263,500	38.7	49.5	14.9								
5	OPERATION FOR 1956 PURCHASE - 1 BOILER 850# 175,000 #/HR 1 TURBINE 7500 KW EXTRACTION CONDENSING	WINTER	0	15,400	15,400	242,500	76,000	318,500	23.8	57.0	18.0	14.5	131.00	983,000	500,000	0	1,483,000	1,572,000	334,000
		SUMMER	0	15,400	15,400	161,500	91,500	253,000	36.2	51.5	14.3								
6	OPERATION FOR 1956 PURCHASE - 1 BOILER 850# 175,000 #/HR 1 TURBINE 5000 KW TOPPING	WINTER	0	15,400	15,400	242,500	81,500	324,000	25.2	56.2	18.3	14.5	131.00	983,000	500,000	0	1,483,000	1,300,000	334,000
		SUMMER	0	15,400	15,400	161,500	85,200	246,700	34.5	53.0	14.0								
7	OPERATION FOR 1956 PURCHASE - 1 BOILER 1250# 175,000 #/HR 1 TURBINE 10,000 KW EXTRACTION CONDENSING	WINTER	0	15,400	15,400	242,500	54,000	296,500	18.2	59.8	17.2	13.8	124.00	930,000	500,000	0	1,430,000	1,956,000	387,000
		SUMMER	0	15,400	15,400	161,500	69,500	231,000	30.0	54.5	13.5								
11	OPERATION FOR 1958 NEXT STEP TO CASE 5 PURCHASE - 1 BOILER 850# 1 TURBINE 7500 KW EXTRACTION CONDENSING	WINTER	0	17,000	17,000	260,800	47,200	308,000	15.3	64.0	17.5	14.5	130.50	980,000	500,000	7200	1,480,000	1,409,000	337,000
		SUMMER	0	17,000	17,000	174,200	86,800	261,000	33.2	54.5	14.8								
12	OPERATION FOR 1956 PURCHASE - 1 BOILER 1250 # 175,000 #/HR 1 TURBINE 7500 KW EXTRACTION CONDENSING	WINTER	0	15,400	15,400	242,500	51,000	293,500	17.4	60.3	17.0	13.7	123.00	922,000	500,000	7200	1,422,000	1,961,000	395,000
		SUMMER	0	15,400	15,400	161,500	69,500	231,000	30.0	54.5	13.5								
13	OPERATION FOR 1958 PURCHASE - 1 BOILER 1250# 175,000 #/HR 1 TURBINE 7500 KW EXTRACTION CONDENSING	WINTER	0	17,000	17,000	260,800	18,200	279,000	6.5	67.5	16.6	13.8	124.00	930,000	500,000	7200	1,430,000	1,642,000	387,000
		SUMMER	0	17,000	17,000	174,200	60,800	235,000	25.8	57.6	14.0								
14	OPERATION FOR 1955 PURCHASE - 1 GAS TURBINE 5000 KW 1 WASTE HEAT BOILER	WINTER	0	15,400	15,400	238,500	85,000	317,500	29.8	53.3	13.4 COAL 480 GAL OIL	12.5 COAL 360 GAL OIL	113.0 COAL 47.90 OIL 160.90 TOTAL	1,200,000	558,000	7200	1,765,200	900,000	52,000
		SUMMER	0	15,400	15,400	153,500	112,760	266,300	42.3	45.8	12.5 COAL 393 GAL OIL								
17	OPERATION FOR 1958 PURCHASE - 2 TURBINES 6000 KW EXTRACTION CONDENSING 2 BOILERS 850# 150,000 #/HR	WINTER	0	17,000	17,000	250,500	34,000	284,500		63.4	13.75 COAL 680 GAL OIL	11.25 COAL 560 GAL OIL	101.20 COAL 47.40 OIL 148.10 TOTAL	1,115,000	478,000	7200	1,600,000	2,496,800	217,000
		SUMMER	0	17,000	17,000	164,200	76,000	240,000		54.0	8.3 COAL 393 GAL OIL								

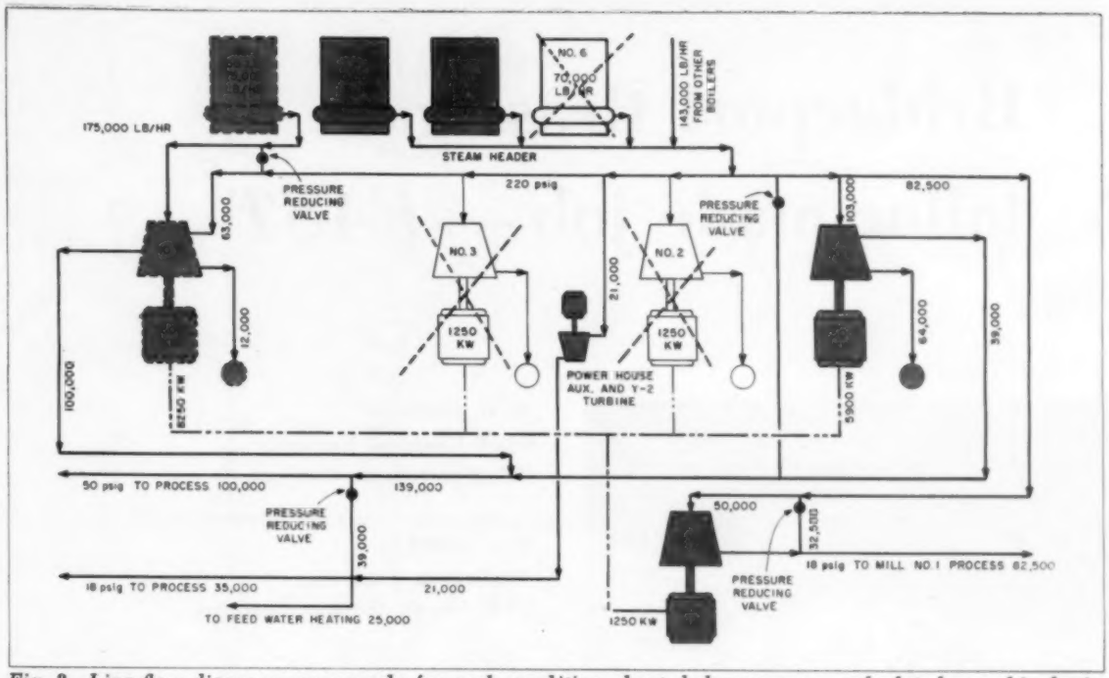


Fig. 2—Line-flow diagrams were made for each condition—heat balances were calculated on this basis.

New fuel-oil storage facilities would be required, whereas existing coal storage area would remain unchanged. When additional cost of fuel-oil storage facilities was considered, the economic advantage of coal became further obvious.

Potential fuel cost reduction was made possible by selecting a boiler capable of burning coals of diversified quality and characteristics. Existing boilers were limited to burning coals with fairly high ash-fusion temperatures. These coals from Virginia, West Virginia, and Eastern Kentucky have ash-fusion temperatures of approximately 2500 F and greater. New boiler has a liberal area of effective projected radiant surface that will permit burning coals with 2000 F ash-fusion temperature. This opens the way to burning Illinois, Indiana, and Ohio coals should these coals be economically attractive.

detailed coal-firing studies

Studies of pulverized coal firing versus spreader-stoker firing were made. Pulverized coal was selected because of higher boiler efficiency it offered under every-day operating conditions. This decision was based on the following facts:

- For spreader-stoker firing, 33 to 35 percent excess air would be required to prevent smoking. With light loads, excess air would probably reach 50 percent. Compared to this, pulverized coal firing requires from 22 to 25 percent excess air. It is obvious, therefore, that stack loss with a spreader unit would be considerably higher.
- Carbon loss with pulverized coal firing would be about 1 percent. With spreader-stoker firing, loss would be from 2 to 3 percent. Spreader stokers, of continuous ash discharge type, are normally justified in areas where low cost coal is available, or where plants operate at lower pressure or with low use factors.

Even though space for heat recovery equipment was available to give the same flue gas outlet temperature, pulverized coal firing would be 1.5 to 2 percent more efficient. Carbon loss, even with cinder recovery, would amount to this value. Furthermore, continuous ash discharge spreader stoker offering an efficiency within 2.0 to 2.75 percent of pulverized coal would cost more initially. More refractory maintenance would be necessary with a spreader-stoker unit, as exposed refractory is necessary to maintain ignition—especially at light loads.

Preheated air for spreader stokers is limited to 350 F, because higher temperatures drastically increase grate maintenance. It would require a combination of air preheater and economizer to obtain maximum heat recovery from flue gases with a spreader-stoker installation. Space limitations precluded this combination.

Final decision called for a Ljungstrom regenerative air preheater with a hot-air bypass to maintain cold end metal temperature above the gas dew point. Prat-Daniel flyash collector is also provided in the draft system. This selection was made in consideration of the importance of cleanliness in paper manufacturing. Cleanliness is even more important to KVP, which manufactures food protection paper.

Fig. 1—Results of heat balances were tabulated to compare the advantages of each possible operation.

From a study of the heat balances (Fig. 1) a Combustion Engineering boiler having continuous rating of 175,000 lb/hr was selected to operate at 850 psig turbine throttle pressure at 825 F. In planning the work, primary importance was placed on uninterrupted operation during construction in the power plant. Due to this limitation, the ultimate plant could be achieved only through a step-by-step procedure—with one boiler and one turbogenerator installed at each step (Cases 5 and 11, Fig. 1).

When preliminary engineering data (Fig. 2) and heat balances were completed, consulting engineers were retained to verify the results obtained. In addition, utility company engineers were consulted. Their findings agreed with those of the KVP engineering staff and consultants.

In addition to considering the boiler plant as a separate entity, consideration was also given to existing plant equipment and the 188,000 lb/hr year-round average process steam requirements.

All of KVP's engineering analyses were not perfunctory operations that merely considered replacing existing equipment with today's counterpart. This would only perpetuate existing inadequacies and lack of flexibility. KVP's engineering studies were undertaken with the idea of designing a simple, rugged, self-sufficient and economical installation that would take advantage of technological improvements made since the older plant was designed.

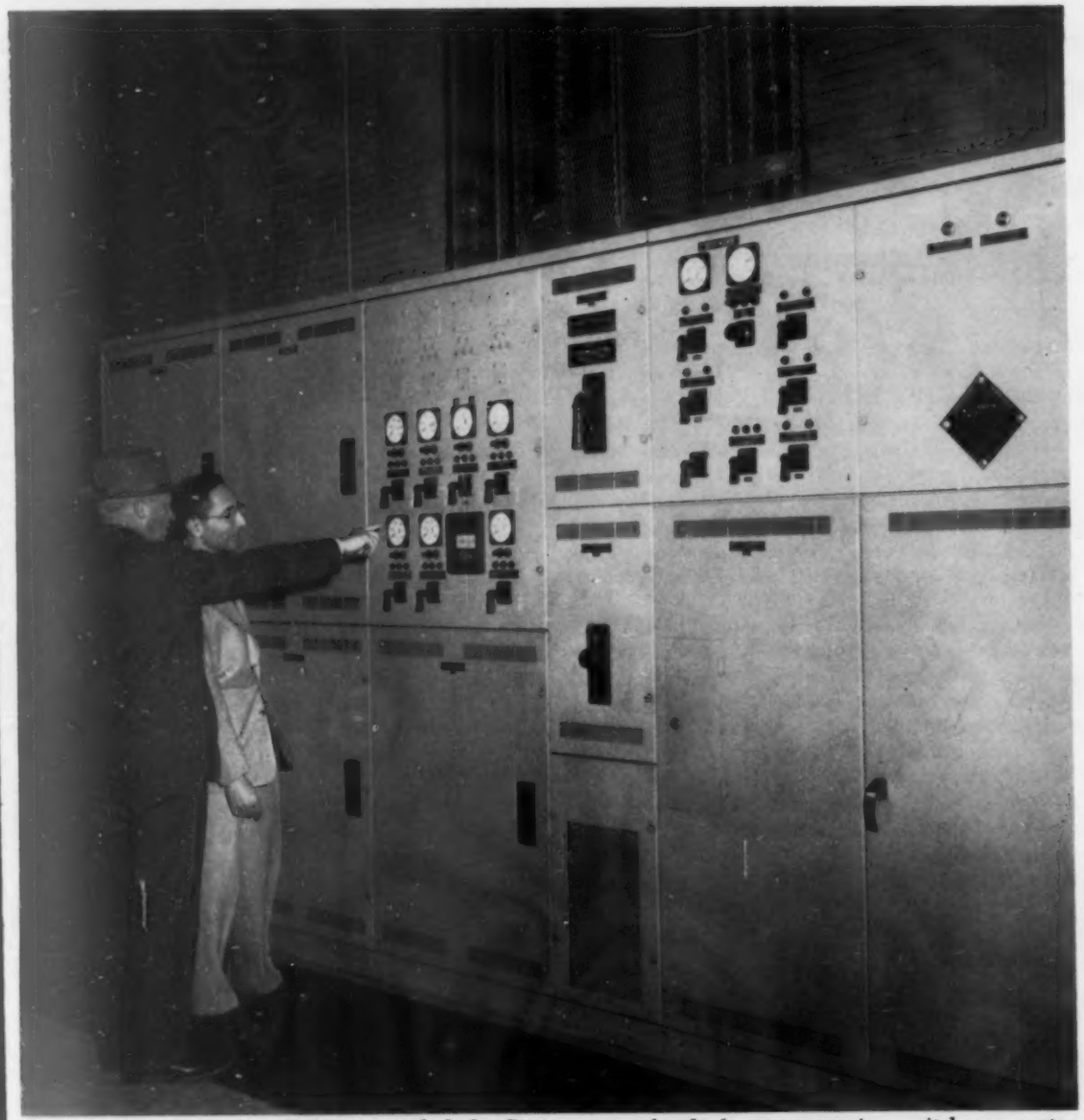
Ultimate power plant (next step to Case 11, Fig. 1) will consist of three boilers, identical or equivalent to the present, each having a continuous rating of 175,000 lb/hr. They will be paired with three double automatic extracting condensing turbogenerators. Each turbogenerator will be rated at 7500 kw, extracting at 220 psig and 50 psig and exhausting at 2 in. Hg absolute.

plant-wide participation helps

Throughout the program, comment was invited from all departments—purchasing, maintenance, and production—to make everyone feel that they participated in the progress and success of this power services installation. In this way, staff engineering can do the basic engineering based on its intimate knowledge of its own plant's power demands, and arrive at a solution that is mutually satisfactory to all company interests. Outside assistance from consultants verifies the findings of the plant engineering staff. This example of how KVP engineers selected their own equipment without interrupting normal operating processes is proof that the staff-engineering method can be outstandingly successful.

How off-the-shelf switchgear and adroit engineering pay off as . . . .

Bridgeport Brass gets tailor-made job — *FAST*



Coauthors B. G. Forbes (pointing) and J. L. Grim survey the final, neat-appearing switchgear center.

B. G. FORBES
Chief Electrical Engineer
Bridgeport Brass Company

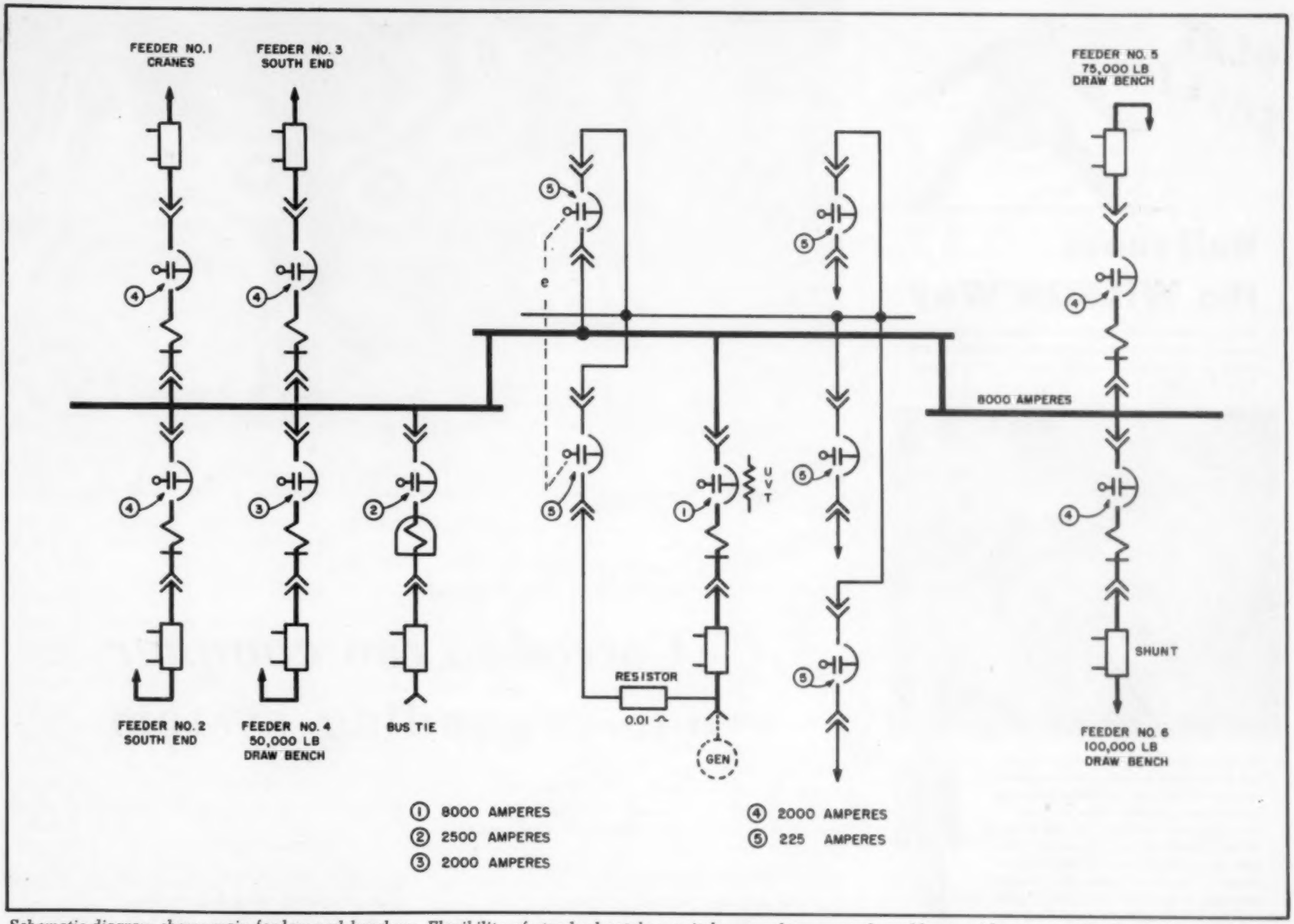
J. L. GRIM
Application Engineer
I-T-E Circuit Breaker Company

YOU CAN MEET STIFF engineering requirements without expensive custom equipment if you use all the versatility built into modern unit switchgear. Tailor-made job from standard, catalog-listed switchgear at Bridgeport Brass Company proves just that. Bridgeport Brass' expansion of its Housatonic power pool seemed to be, at the outset, a tailor-made job if all conditions were to be satisfied. But adroit engineering of the Bridgeport job, typical of engineering behind industrial power expansion programs over the past 10 years, proves the universal adaptability of modern standard switchgear.

management planned for expansion

Two years ago, management at Bridgeport Brass realized that planned increases in tube-mill capacity would call for expanding available plant power dc to 6000 kw. Plans called for a new 1500-kw motor-generator set plus associated equipment. Immediately, as with most expansion programs, floor space was found to be at a premium. Sound engineering and basic economics dictated that the new generating equipment be placed midway on one side of the 1000-foot tube-mill building. Available space was limited for this new m-g set. Equipment consisted of primary metal-clad drawout switchgear, various other electric control equipment, and dc metal-enclosed drawout switchgear.

Switchgear location was definitely confined by proximity of the m-g set, primary switchgear, mill equipment control stations, and building wall. Position of the 8000-ampere generator leads established, to some degree, limits of assembly within its alloted floor space. Initially proposed layout called for one



Schematic diagram shows main feeders and breakers. Flexibility of standard catalog switchgear solves control problems without use of tailor-made components.

feeder circuit per switchgear frame. This would use a minimum of floor area. Future expansion, based on this layout, would be limited to one additional feeder circuit at each end of the switchgear assembly.

Switchgear supplier's recommendations resulted in saving considerable space and permitted consolidation of associated m-g field protection components. Reviewing basic requirements, advantages were shown for applying standard drawout metal-enclosed units and using "2-high" construction for feeder and bus tie circuits. This reduced switchgear floor area to one-half that originally assigned to each feeder. Two feeder circuits per frame were now to be used for future expansion. This doubled the expansion potential per unit area of floor space.

Compactness of this improved arrangement created sufficient space to permit merging the field protection equipment with the main distribution switchgear. Two standard frames of drawout, metal-enclosed, 600-ampere frame breakers were added. Although these two frames were separated by the 8000-ampere 2-pole generator breaker, standard frame construction was used.

Standard switchgear provides cable entrance from above or below. No design changes were required to locate the equipment directly over a cable basement running the entire length of the room. Generator, bus tie, and radial feeder breakers are all standard, electrically operated units designed for 250-volts dc closing and 48-volts dc tripping. Main distribution switchgear provides the following circuits:

- One 8000-ampere, 2-pole, truck-type main breaker for the 1500-kw generator.
- Two 2500-ampere, 2-pole, drawout breakers for bus tie and radial feeder.

(continues on page 31)

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Corrosion pitting (circled) penetrates lead cable sheath, and allows voltage to puncture through (center).

Protect your plant's electric-system grounds because . . .

Corrosion can *conquer* your grounding system

L. P. SCHAEFER
General Manager
The Hinchman Corporation

YOUR GROUNDING SYSTEM is only as good as the corrosion protection you give it. But normal grounding practice generally neglects underground corrosion. This leads to considerable damage to primary structures. Corrosion of underground structures is due to several causes:

- Small anodic and cathodic areas of buried metal due to welds, splices, scratches, and abrasions.
- Alternate wet and dry soil or duct runs, dissimilar electrolytes, or direct chemical attack.
- Galvanic effects due to copper bonds, ground connections, or proximity to other metals.
- Stray currents from industrial chemical operations, electrified railways, or dc cranes.

Corrosion protection for industrial plant grounding may consist of insulating procedures, avoiding use of dissimilar metals, draining stray currents, or cathodic protection combined with the complete plant equipment grounding system.

Good grounding means safety to personnel and equipment. System performance should not be vulnerable to corrosion. Low resistance is desirable for most electric grounding systems. Grounding resistance is also a design criterion for ground beds that supply cathodic corrosion protection for buried metallic structures. For example, low soil-resistivity makes low ohmic grounding relatively inexpensive. But this same soil, being an electrolyte, will support underground corrosion much easier than a high-resistance soil. Thus arises need for corrosion control in good grounding systems. Low soil resistivities make anode ground beds for cathodic protection easier to design.

Grounding systems consist of rods and conductors

driven or buried in the ground. Ground rods driven into the earth make the earth an electric conductor in the grounding circuit. Since the earth has tremendous cross section, it has relatively low electric resistivity. But ground-rod path to the earth has finite resistance, which varies directly with soil resistivity and inversely with ground rod length. Soil resistivity depends on soil texture, moisture, compactness, aeration, and dissolved salts.

Earth, as an electric circuit element, is measured in terms of its electric resistivity. Soil resistivity generally becomes lower as the depth below grade increases, because soil has more moisture farther down.

low soil resistance best for system

Grounding system soil should provide lowest ohmic resistance economically feasible. Resistivity for any installation must be calculated for the actual ground bed location because of wide variations in soil resistivity. Table I shows ground rod resistance in ohms for ¾-inch diameter by 8-foot-long and by 20-foot-long rods.

Table I shows that a grounding system adequate in 2500 ohm-cm clay soil would be inadequate in sandy soil of 20,000 to 50,000 ohm-cm. If a 25-ohm ground were desired, for example, and the ground rod was driven in 20,000 ohm-cm soil, driving the rod 20 feet deep still would not produce desired ohmic resistance.

Rock or other subsoil conditions often prevent using long ground rods. Multiple short rods, buried horizontal wire, or a counter poise system may be necessary. Resistance of shallow grounds varies due to seasonal temperature changes and changes in moisture conditions due to fluctuating water table. A 50-ohm ground in 5000 ohm-cm soil, for example, will cost approximately $48.00. Same ohmic ground in 20,000 ohm-cm soil requires an extensive counterpoise system using multiple-driven rods costing an estimated $144.00.

Acceptable structure ground resistances depend on a number of factors including voltages, fault currents to ground, limitations of surge and lightning voltages, and system neutral grounding. Actual values depend on the structure and the type of grounding desired. Industrial plant power substations, for example, should relate substation grounding resistance to calculated line-to-ground fault currents. Static grounding at storage installations for fuel oil, gasoline, or solvents is usually of the 25-ohm variety — with explosion-proof switching equipment if necessary. Table II lists approximate values of grounding resistance.

TABLE I

Resistance of Driven Ground Rods

Soil Resistivity (Ohm-Cm)	Resistance (Ohms) ¾-in. x 8-ft rod	¾-in. x 20-ft rod
500	2	0.9
1000	4	1.8
2500	10	4.5
5000	20	9.0
8000	31	14.0
10,000	39	18.0
20,000	78	36.0
50,000	195	90.0

Some 20 percent of all injuries caused by electric equipment are related to contact with housings, frames, or enclosures of parts not carrying current. Dangerous potentials different from ground are also obtained in the following ways: induction from lightning, fault, or abnormal currents as a result of electrostatic or magnetic fields; insulation failure and breakdown; fault flashovers from energized circuits; and lightning and impedance drop as a result of current flow to earth.

All parts not carrying current should be connected together and grounded so that all equipment and building structures are at the same potential. Grounding consists of a grid or network connected to the equipment which, in turn, is connected to driven ground rods. Ground bus should provide multiple paths to ground so that a single broken connection will not open the path to earth. For mechanical strength, ground bus should not be smaller than No. 2/0 wire. No. 4/0 usually is used for industrial plants. Ground bus from transformer or switchgear housings usually consists of No. 6 wire to connect to the plant ground bus. A 2-inch by ¼-inch copper bar is commonly used as a ground bus in and around industrial plant substations.

special grounding for semiportables

Semiportable equipment, such as machine tools not bolted to the plant's structural frame and portable equipment, also require grounding. Unless such equipment is properly grounded by other means, a ground conductor is provided in the cable to the machine. Ground bus in busways is connected to the plant ground. Bus housing may provide a satisfactory ground return, also.

Small portable apparatus is usually a problem because of the variety of equipment involved. Portable equipment is widely used in industrial plants. Personnel generally are not familiar with electric circuits involved. Special 3-pole outlets with a third grounding conductor should be used. Neutral conductors may be grounded, but separate conductors should be used for grounding the equipment itself.

Enough voltage may be induced in mechanical equipment — such as buried pipelines, pipe-type cables, and conduits — to give mild shocks. Reducing pipe lengths with insulating joints and installing grounding mats or grids at each fitting prevents such shocks to operating personnel. (Grounding may be combined with corrosion control by using sacrificial magnesium or zinc anodes to give cathodic protection to the pipe as well as to the grounding system.)

Where voltages are induced in underground equipment as a result of lightning or phase faults, the worst conditions prevail where direct short circuits are made to aboveground portions of the pipe. If such conditions are apt to occur in or around an industrial plant, low resistance grounding is advisable for buried pipe. This is particularly important for aboveground or buried piping which is new and has a good grade of enamel and felt-wrap coating. Such coating has high dielectric resistance and will not permit induced voltages to leak off.

what is cathodic protection?

Corrosion is electrochemical. Small electric currents leave a metal surface, causing metal ions to go into solution. Corrosion results. If this current can be prevented from leaving the metal surface by supplying an opposing current of sufficient magnitude to overcome the current originally causing the corrosion, the corrosion is halted. This is called cathodic protection.

Cathodic protection uses two methods. One method, the galvanic or sacrificial anode system, uses magnesium or zinc electrically connected to the protected structure to form a galvanic cell. Current then flows from the magnesium or zinc to the structure being protected — destroying the magnesium or zinc anode but protecting the structure. The other method of cathodic protection is the impressed current system. A rectifier and an anode bed of graphite or steel sets up a bucking current to cancel the initial corrosion-producing current.

Major industrial plants have a complex variety of underground utilities — such as electric power and telephone cables; water, air, fuel oil, and gasoline piping; industrial solvents and waste systems; sewage piping; steam and condensate returns; steel

TABLE II

Grounding Resistance for Various Structures

Structure	Grounding (Ohms)
Lead cables in underground ducts	Normal: 25 Terminal equipment: 5
Substations	Major: less than 1.0 Minor: less than 5.0 Equipment: less than 25
Power tower lines	Normal: 10 Primary distribution: 20 to 80
Industrial plant equipment	From less than 1.0 to 25
Static grounding	Hospital floors: 100,000 to 1 megohm Fuel handling: less than 25

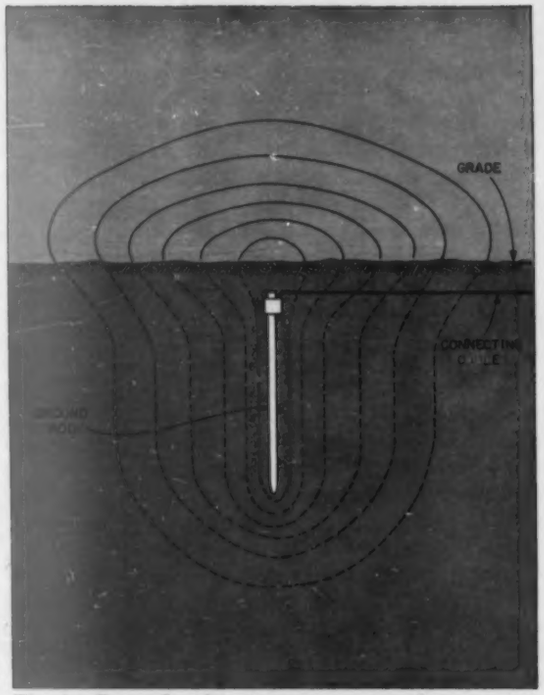


Fig. 1—Ground rod resistance pattern shows resistance decrease with increasing distance from rod.

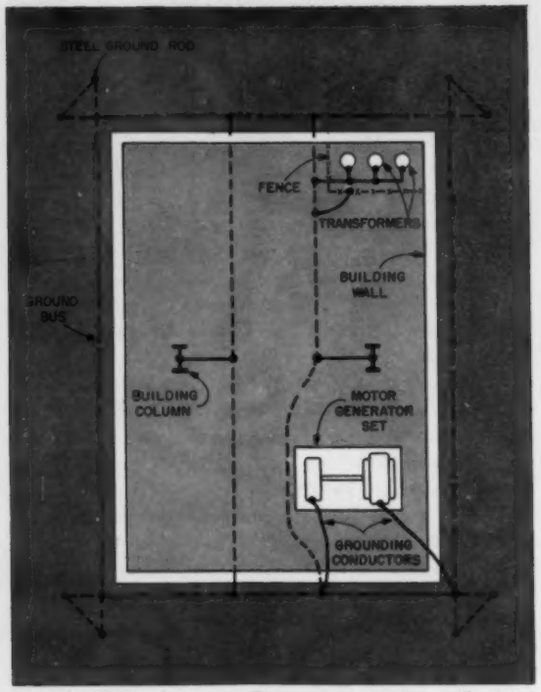


Fig. 2—Typical grounding system for industrial components without corrosion protection methods.

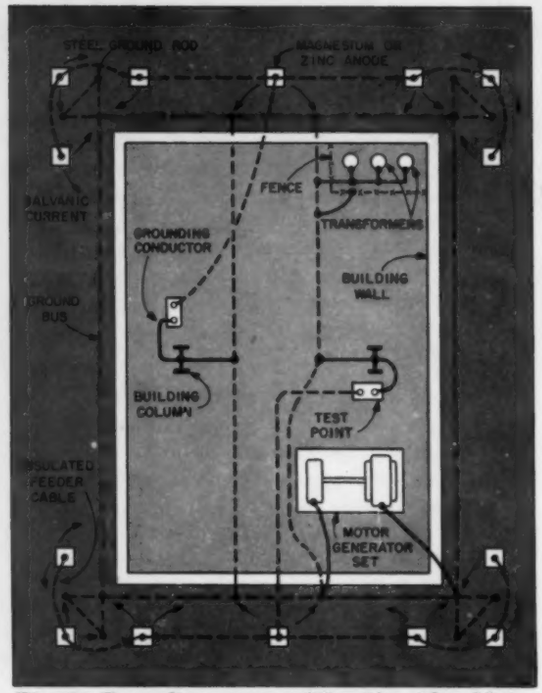


Fig. 3—Grounding system (Fig. 2) with addition of sacrificial anode cathodic protection system.

building columns; and on grade and underground storage tanks.

Electric grounding systems can be, and usually are, connected to all plant utilities (as shown in Fig. 2). Grounding, consequently, may be supplied by these utilities as well as by the actual grounding system. Although nonferrous ground rods (such as copper) are functionally satisfactory, corrosion-free existence of copper may occur at the expense of underground steel and lead structures.

how underground corrosion occurs

Underground lead cables, for example, may present a corrosion problem where heavy copper ground bus and driven copper rods are nearby. As an example, lead cables in ducts may be bonded to bare copper conductor in the duct envelope — resulting in galvanic corrosion. Stray dc, on the other hand, may be flowing in the cable sheath. Electrolysis occurs when the stray current leaves the cable sheath, resulting in corrosion and eventual cable failure. Existing copper grounding may have to be cut free. New grounding may be substituted — using heavy zinc-coated steel ground rods and zinc or magnesium anodes for cathodic protection of both the lead cable and the grounds.

Corrosion may be stopped on industrial plant or substation underground cables and conduit systems by using neoprene or polyethylene coatings on cables and by using a tape-wrap or bituminous-paint coat system for conduit. This will nullify galvanic current. Corrosion will not take place. Industrial plant grounding of Fig. 2 is shown with sacrificial anodes in Fig. 3.

Current for cathodic protection of a primary structure may have to be of great magnitude. This current may be more economically supplied from a rectifier and a graphite-anode-type of impressed current system than from the natural galvanic action of a sacrificial anode. No special provisions are necessary when sacrificial anodes are used to supply cathodic protection to a grounding system subject to fault currents. Such anodes are an integral part of the grounding system. Rectifier-type cathodic protection, on the other hand, requires some special technique when associated with grounded systems subject to heavy fault currents. A primary storage cell and a spark gap paralleling the primary cell and rectifier usually offers adequate protection. An impressed current system for lead cables and ground bed is shown in Fig. 4.

Corrosion always must be considered with grounding systems for discharging static electricity. Most effective system uses principles shown in Fig. 3.

Some type of stray dc problem usually comes up in industrial plants if no attention is given to its control. Stray dc current may come from electric traveling cranes, welding equipment, plating process equipment, dc control circuits, motor-generator sets, battery chargers, railway stray currents and signal circuits, or special grounding circuits on communication and fire alarm equipment. From a corrosion point of view, stray dc is most troublesome.

Stray ac may be steady-state or transient. Though stray ac poses hazards to personnel and equipment, it rarely will cause corrosion.

system study finds corrosion

Proper solution to the problem may require a system study involving structure-to-soil potential measurements with a millivoltmeter-recorder. Time recordings of voltages and currents at crossings and adjacent points will reveal locations where current drainage should be provided. Grounding, either separately or combined with cathodic protection, may also be required for mitigation of the stray-current problem.

Stray currents that do not show fluctuations may be most difficult to track down. Sources of such currents are battery chargers and battery-powered equipment — such as communication or fire-alarm equipment. When the source of such problems has been determined, however, mitigating measures usually are relatively simple compared to the fluctating problem. Sacrificial anodes is one frequently used method to prevent these stray-current problems.

Problems from induced voltages producing transient and steady-state ac in parts not carrying current generally may be solved by an understanding

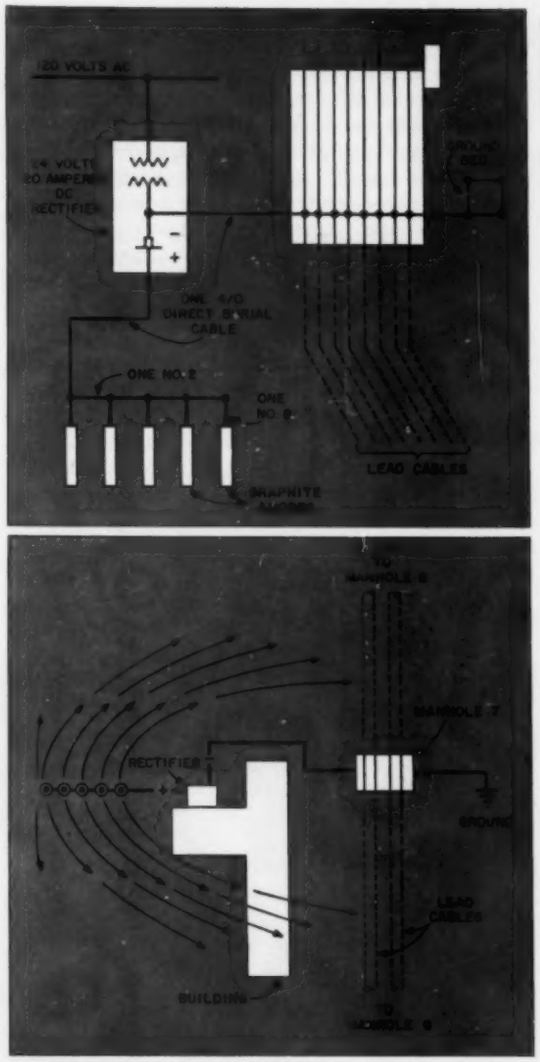
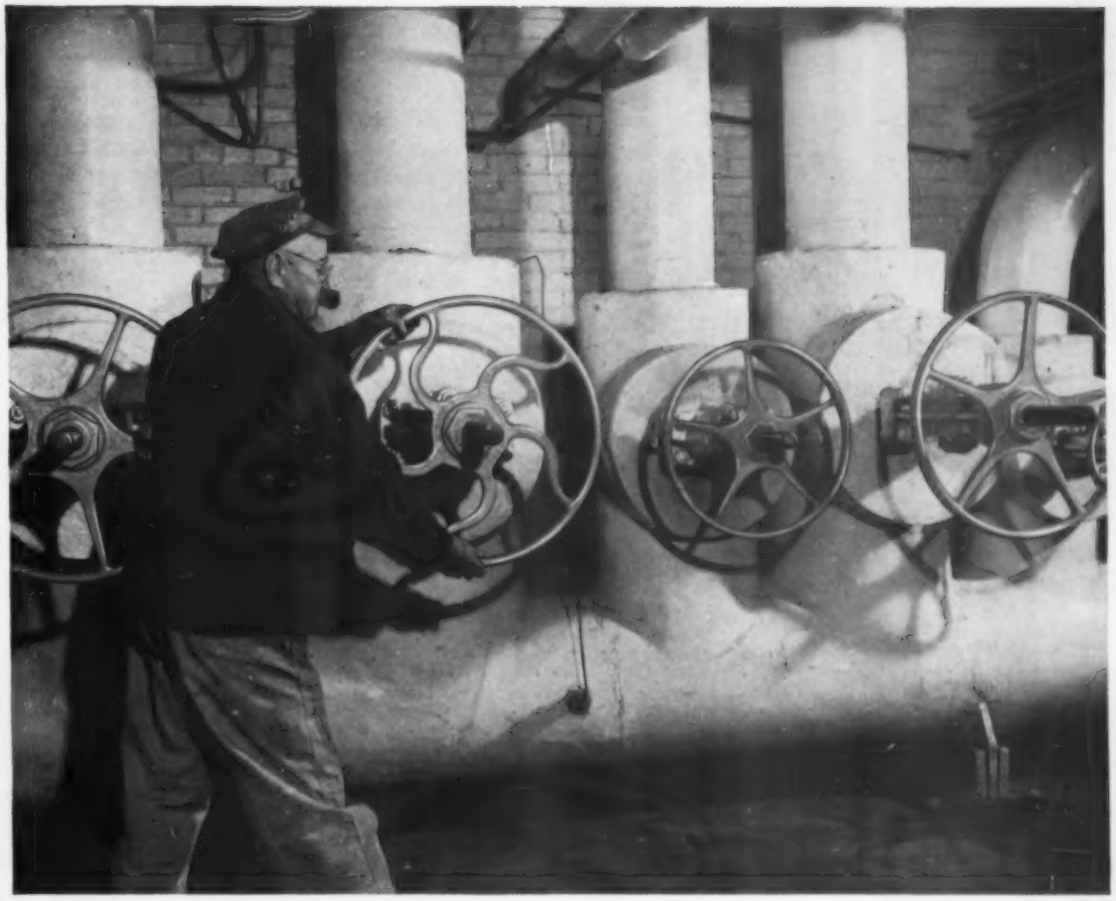


Fig. 4 — Electric schematic diagram (above) shows current flow for the physical installation (below).

of the problem involved. For example, if induced ac voltages on a pipeline in or around an industrial plant are the problem, the solution may require insulating pipe joints and installing grounding grid at either side of each pipe joint. Heavy surge currents in grounding systems may make impossible use of sacrificial anodes alone for grounding. Cathodically protected ground rods may be desirable.

Grounding system principles are not difficult to follow. Installation and maintenance generally require methodical testing of the basic system components. Grounding systems, however, do need corrosion protection to obtain the twofold advantage of protecting personnel against dangerous potentials, and eliminating costly replacements required by corrosion failures.



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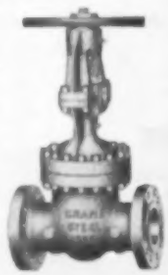

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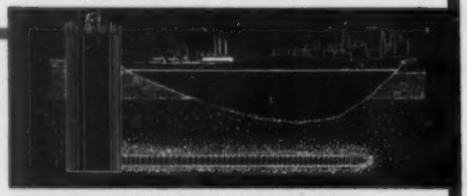

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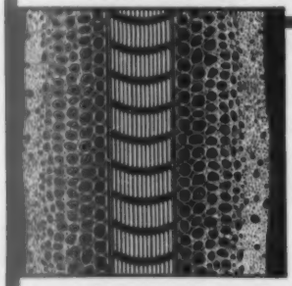

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Centralized controls

. . . starts on page 12

central control room, with a handset mounted at the control consoles. Tests were run to determine the best locations for the 20 speakers and handsets throughout the building.

Control panel was built by Panellit, Inc. in cooperation with Sargent & Lundy, who designed the boiler addition.

Control room is air conditioned by a unit air conditioner, and lighted by diffused fluorescent lights.

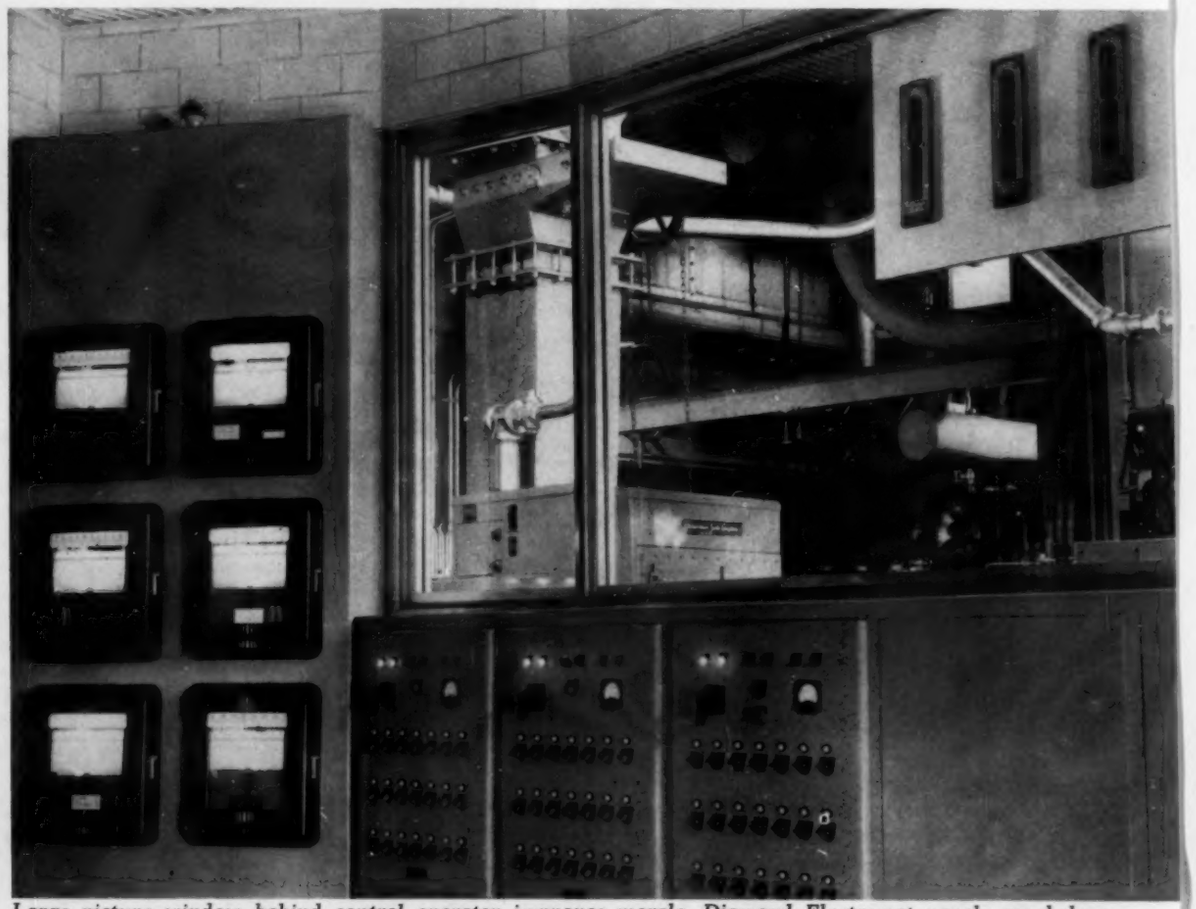
Large multipoint temperature and conductivity recorders and other miscellaneous recorders are located in panel sections on either side of the picture window, directly behind the operator. Three 20-point Diamond Specialties automatic soot blower control units are housed in a cubicle beneath the window. Outside the window are three Reliance Eye-Hye remote water level indicators. They are located outside because they are direct-connected.

Switchover from localized to centralized control was done without a hitch. It was done one boiler at a time to allow for adjustment and tuning up. When control of the first boiler was transferred, one crew operated the boiler from control room while a second crew operated the other boiler from its local control panels. In this way, operating crews gained valuable experience with the new equipment. Two weeks later, the third boiler was put on the line from the central control room without incident.

This third boiler is a Babcock & Wilcox 250,000 lb/hr Sterling-type 650-psig, 750 F boiler. Fuel is pulverized coal. Equipment includes a pendant three-loop superheater and B & W straight-tube-type air preheaters. Boiler has 5200 sq ft of heating surface and is equipped with consolidated safety valves and Edwards blowdown valves.

Centralized control has been a big help to the instrument maintenance program. All instruments and controls can be checked at a glance, and any malfunction detected quickly. Most trouble-shooting is done right in the control room, which saves time.

Duplicate instruments, such as indicators on the



Large picture window behind control operator improves morale. Diamond Electromat panels are below.

panel, recorders on the console, and (in some cases) integrators on the end panels, serve as a check on each other. In emergencies, one is used while the other is being repaired. Malfunction is immediately apparent to the operator. Repairs can be made without base loading the boiler, or without putting a particular control system on manual control.

Backs of all panels are open and accessible from the rear, so maintenance is simplified.

Behind the graphic panel section of the control room is a small, well-equipped instrument shop. It is stocked with the tools, drawings, and manufacturers' manuals for prompt, efficient, maintenance.

Approximately 500 major instrument items are used for control of these three 250,000-lb/hr boilers. No downtime has been experienced yet because of instrument failure.

One operator looks after all three boilers in the control room. One assistant checks blowers, takes readings of temperature charts every two hours, and reads coal scales every hour. Each shift is assigned a boiler, and is responsible for cleaning out inspection doors and also for cleaning any slag built up on tubes or burner throats.

Each shift must inspect all operating equipment and balance the nine Richardson coal scales. No-coal alarms are checked each shift. No. 1 and No. 2 boilers are sootblown twice a day. No. 3 boiler (the newest) is sootblown only once a day. Sootblowing takes about one hour for the full sequence. Two older boilers require longer sootblowing because of the previous method of water lancing and because of their greater age. Slagging is only slight nowadays.

Centralized controls in 18 months have proven many benefits:

- Substantial labor savings by elimination of an extra boiler operator per shift.
- Reduction of floor space around boilers.
- Reduction in operator training time. In fact, only semiskilled labor is used for operation. Some operators had never even seen a boiler three years ago.
- More complete understanding of the boiler operation by control operators.
- Better coordination of boilers in emergencies.
- Automatic sootblowing operations under control of one boiler operator. Boilers are cleaner. Less steam has been used to keep them clean.
- Improved operator comfort.

Although the decision to change to centralized controls was debated at first in view of the existing investment, it has been proved fully justified. Only by taking advantage of such modern developments can a growing power plant sidestep continual obsolescence and keep on giving management most for its money.

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Polyphase alternating current circuits

Part V

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FOR A GIVEN output, polyphase generators or motors are lighter and less expensive to manufacture than single-phase machines. Also, polyphase motors are self-starting — without need of the extra windings and devices required by single-phase motors for positive starting. From the standpoint of motor operation, therefore, any polyphase system is preferable to single-phase. From the standpoint of power transmission, the 3-phase system offers material savings. It has become the recognized standard for generation, transmission, and distribution. Lighting service, in final analysis, must be connected as a single-phase load. But single-phase lighting circuits can be connected to different phases of a polyphase system in a manner that maintains reasonable balance between the phases — thus preserving the general advantages of polyphase systems.

In 3-phase generators, three identical sets of coils are placed around the frame to supply three equal voltages, each displaced 120 degrees from each other (Fig. 1). Coil ends are brought out and interconnected.

To form a *star connection,* corresponding ends of the three coil-sets are connected together to form a neutral (Fig. 2). From this, a 4-wire system may be set up by bringing a neutral line out from the neutral point, or a 3-wire system may be established through omission of the neutral line.

To form a *delta connection,* coils are connected (Fig. 3) start to finish in successive pairs. From each junction point, a connection is made to the outgoing circuit. Although each of the three phase windings form a closed circuit upon themselves, no short-circuit is established because the sum of the three equal

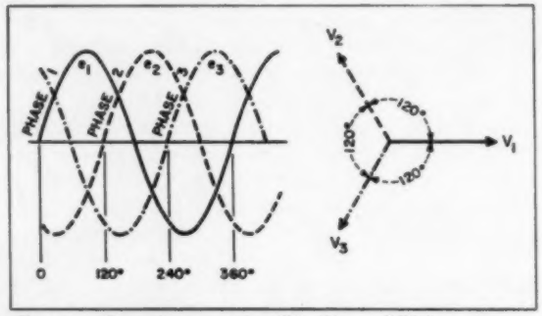


Fig. 1 — Rotating vectors (V_1, V_2, and V_3) represent 3-phase system as does the corresponding sine waves.

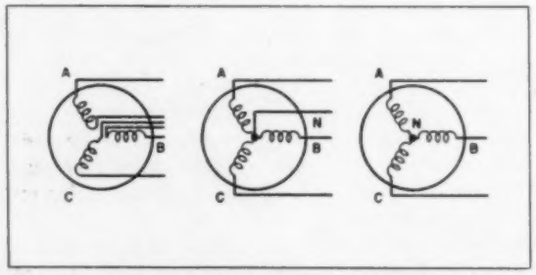


Fig. 2 — Starting ends of coils are each brought out and finish ends are joined together for wye system.

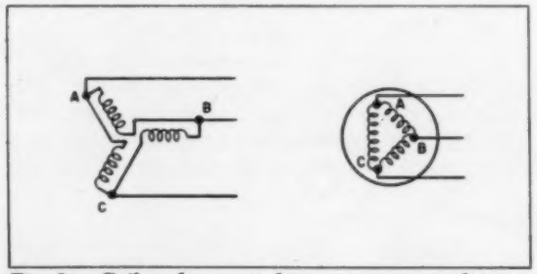


Fig. 3 — Coil ends are tied in succession and junctions are brought out for delta-connected system.

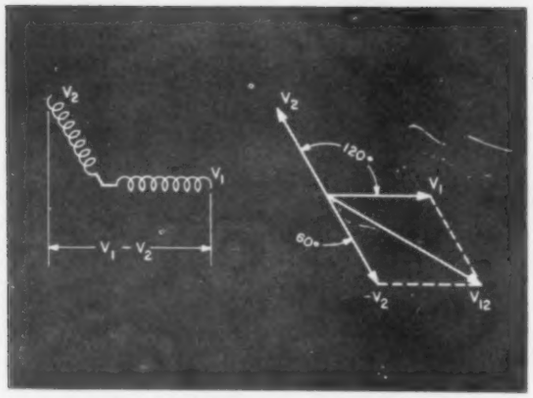


Fig. 4 — Vector difference of voltages in adjoining phase generator coils gives the line-to-line voltage.

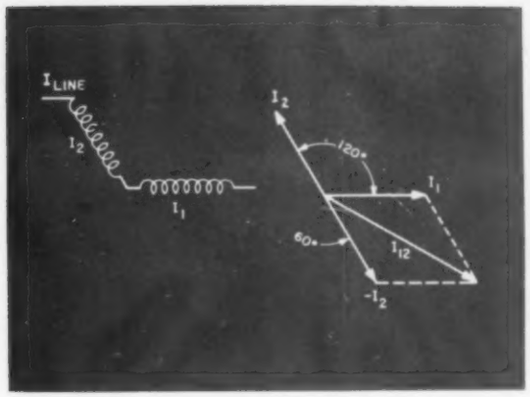


Fig. 5 — Line current is vector sum of phase currents since current waves are displaced in time.

voltages, 120 degrees apart in phase, is equal to zero at all times.

Star or delta connections may be used at the receiving end of 3-phase supply lines. Some restrictions exist in loads that may be connected star, such as lighting, because of unbalanced load conditions. Such loads should be connected delta or between the line and neutral wires if the system is 4-wire. If connected star with a *free* neutral, load voltages are likely to depart radically from normal as the loads become more unbalanced.

In star connection of generator windings or of load, phase currents equal line currents since the line is a continuation of the phase coil. Line-to-line voltages, on the other hand, are vector resultants of two phase voltages. Line voltage (Fig. 4) becomes the vector *difference* of two equal phase voltages 120 degrees apart or the vector *sum* of two equal voltages 60 degrees apart, thus giving

$$V_{line} = (3)^{1/2} (V_{phase}) = 1.732\ V_{phase} \qquad (1)$$

In delta-connection, line voltage equals phase voltage for balanced loads and symmetrical voltages, since line connections are made directly across ends of the phase windings (Fig. 3). Current in the line, however, will be the vector *difference* of two equal phase currents 120 degrees apart or the vector *sum* of two equal phase currents 60 degrees apart (Fig. 5), thus giving

$$I_{line} = (3)^{1/2} (I_{phase}) = 1.732\ I_{phase} \qquad (2)$$

Vector diagrams for unbalanced load currents and power factors may be set up in the same way as for balanced conditions, starting with the line voltages and associating each load current with its applied voltage. Line currents then may be obtained graphically by vector subtraction of the proper phase currents. The $(3)^{1/2}$ relations between phase and line currents do not exist in unbalanced circuits.

Four-wire distribution is a modified star connection, the fourth wire being connected to the neutral point of a star-connected generator. This fourth wire is return line for unbalanced currents on star-connected loads. Single-phase loads are connected between line wires and the neutral line. Balanced 3-phase loads may be connected to the line wires in the usual way (Fig. 6). Lighting loads always should be connected between line and neutral since they are likely to become quite unbalanced at times.

greater capacity in 4-wire

Chief advantage of 4-wire systems, when compared with 3-wire systems, lies in their greater load capacity. It is a natural step in expanding capacity of a 3-wire system that is approaching its load limit in terms of voltage regulation. In changing from a 2300-volt, 3-wire system to a 4000/2300 volt, 4-wire system the existing transformers can be used by shifting one connection to the neutral line. Considerable benefit results from the standpoint of load capacity and voltage regulation since system voltage has, in effect, been raised from 2300 volts to 4000 volts.

Fig. 7 illustrates method of graphically determining neutral-wire current in a 4-wire circuit with unbalanced load.

In 3-phase systems total power may be obtained by determination and addition of the three individual phase powers, regardless of the connection used. Where voltage, current, and power factor are the same in each phase, however, total power requirement may be calculated in terms of line voltage, line amperes, and phase power as follows:

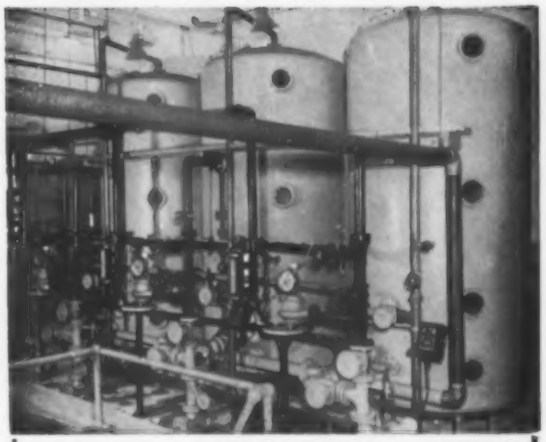
For balanced star . . . .

$$\text{Power} = (3)^{1/2}\ V_l\ I_l \cos \theta_p \qquad (3)$$

It is, therefore, not essential that the type of connection be known. Only line voltages and currents, plus phase power factor need be known when power requirements of a 3-phase load is to be calculated.

In balanced, 3-phase circuit, star- or delta-connected, we get the equation

(continues on page 28)



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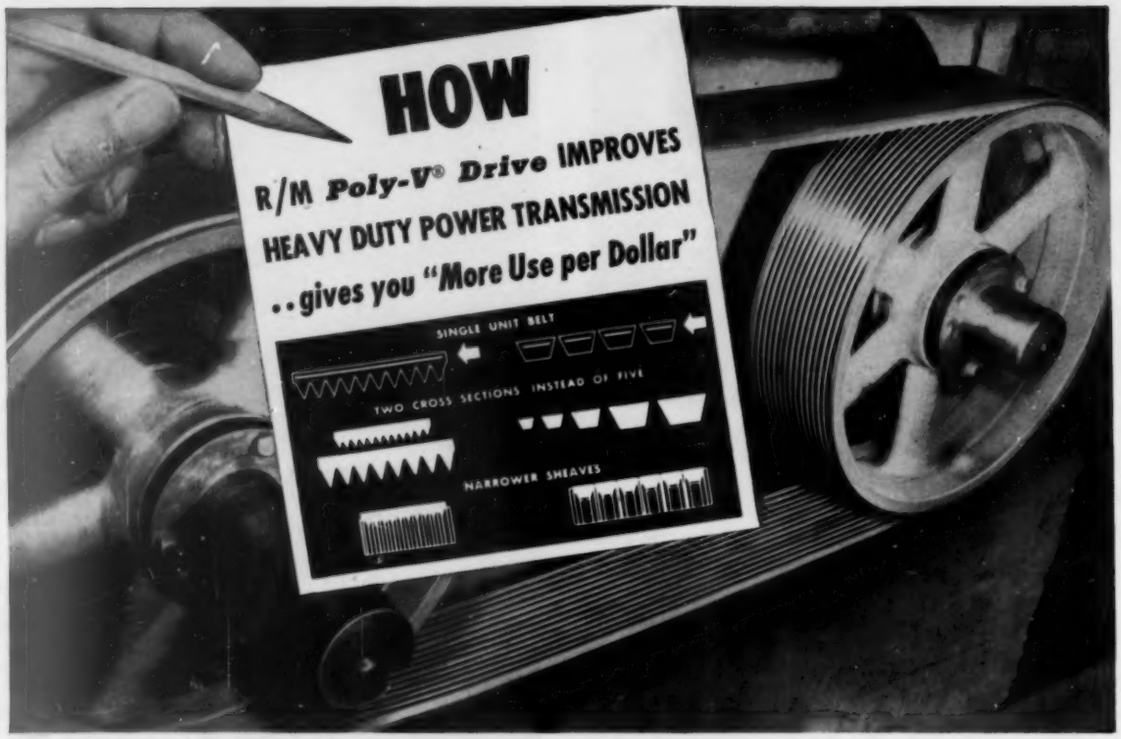

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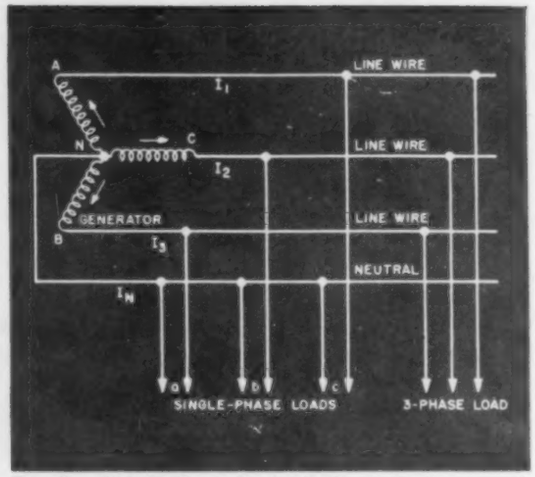


Fig. 6 — Single-phase loads (a, b, and c) are each connected from one phase conductor to neutral.

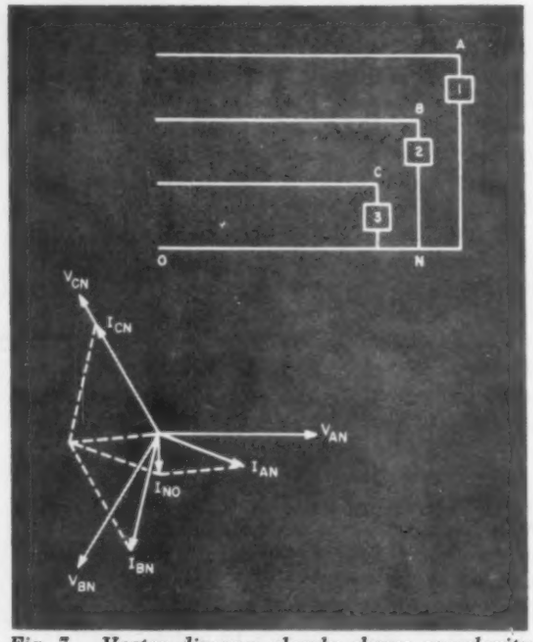


Fig. 7 — Vector diagram clearly shows complexity of typical unbalanced 4-wire, 3-phase ac circuit.

$$KVA = \frac{(3)^{1/2}\, V\, I}{1000} \qquad (4)$$

$$KW = \frac{(3)^{1/2}\, V\, I \cos\theta}{1000} \qquad (5)$$

where V = line voltage
I = line current
phase
θ = power factor angle

Two single-phase wattmeters (or a polyphase wattmeter with two sets of potential and current elements acting upon a common indicator system)

are required for measurement of power input to a load on a 3-phase, 3-wire circuit. For 3-phase, 4-wire circuits, however, three meter elements are necessary. If phase end-connections are available for insertion of instruments into the phases themselves, total power is the sum of the powers in the three phases. Usually, though, only the line wires are conveniently accessible.

For 3-wire circuits, one current element must be connected in series with each of two lines, with the corresponding voltage elements connected between the line in which the current element is connected and the line in which there is no current element. For the 4-wire circuit, current elements must be in series with each of the three main lines and the voltage elements between these lines and the neutral wire.

For the 3-wire system, using the 2-wattmeter method, total power is sometimes the sum or sometimes the difference of the two wattmeter readings. For balanced loading with phase power factors *above* 50 percent, readings are additive. For 50 percent power factor balanced loads, one wattmeter reads zero while the other reads the total power. For balanced loads of *less* than 50 percent, indication on one wattmeter exceeds total power by the indication on the other wattmeter.

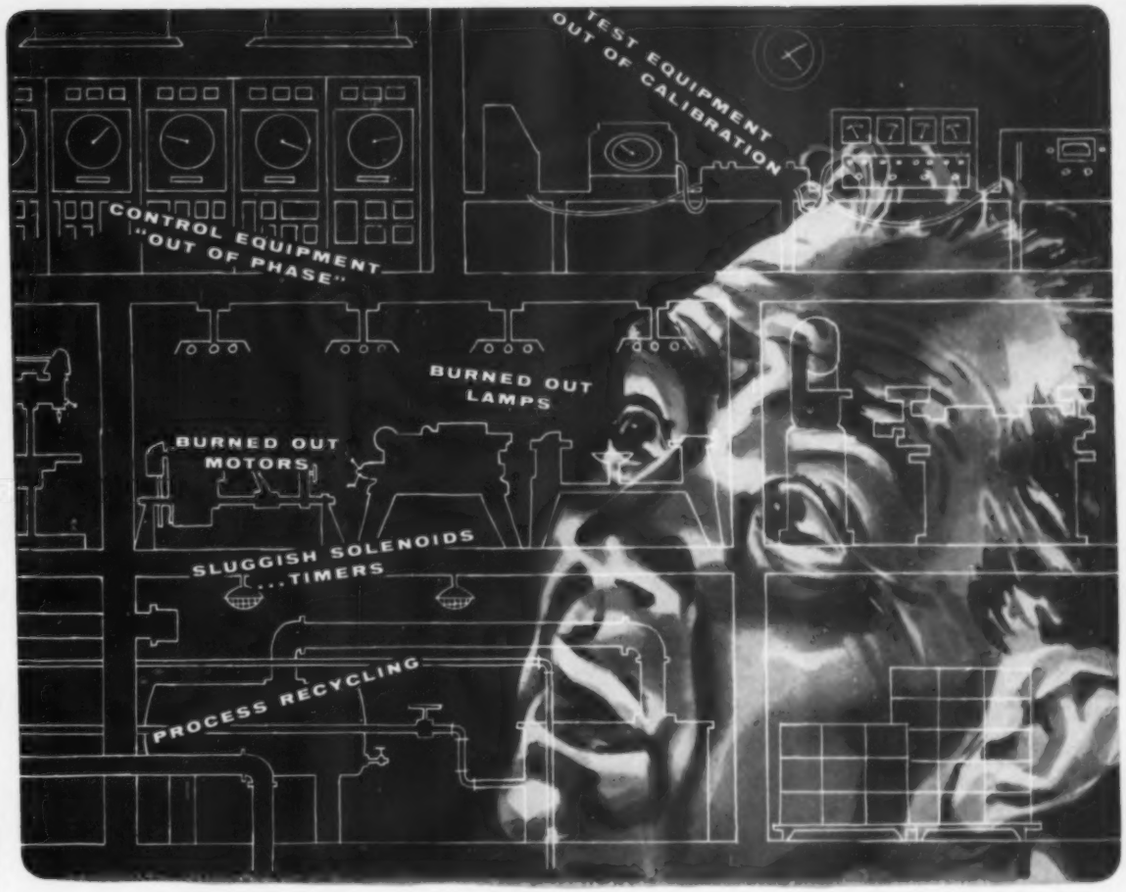
For unbalanced loads, it is sometimes difficult to determine whether the two readings are to be added or subtracted. But if the connections first can be verified for balanced loading, then reversal of one instrument indicates that the correct procedure is to subtract the lesser reading from the greater. For polyphase wattmeters, addition or subtraction of torques (once the proper connections are established) will give net indication automatically, regardless of load balance.

watthour meters measure energy

Watthour meters, for determination of energy transfer by polyphase circuits, should be connected into the circuit according to the same rules that apply to wattmeter connections. Two single-phase meters may be utilized to measure 3-phase, 3-wire energy but a polyphase meter is commonly employed for this purpose. Polyphase meters have two single-phase elements working upon a common spindle and gear train.

Resistance and inductive reactance are factors affecting loss of voltage between the point of generation and the point of utilization in all connecting ac lines. Capacitive reactance also may be an important factor in high-voltage lines of some length.

Conductor size is the important consideration so far as resistance per unit length and power loss in the line are concerned. Conductor size, conductor spacing, and system frequency all affect line reactance. Tables are available giving the resistance and the inductive reactance per thousand feet or per mile



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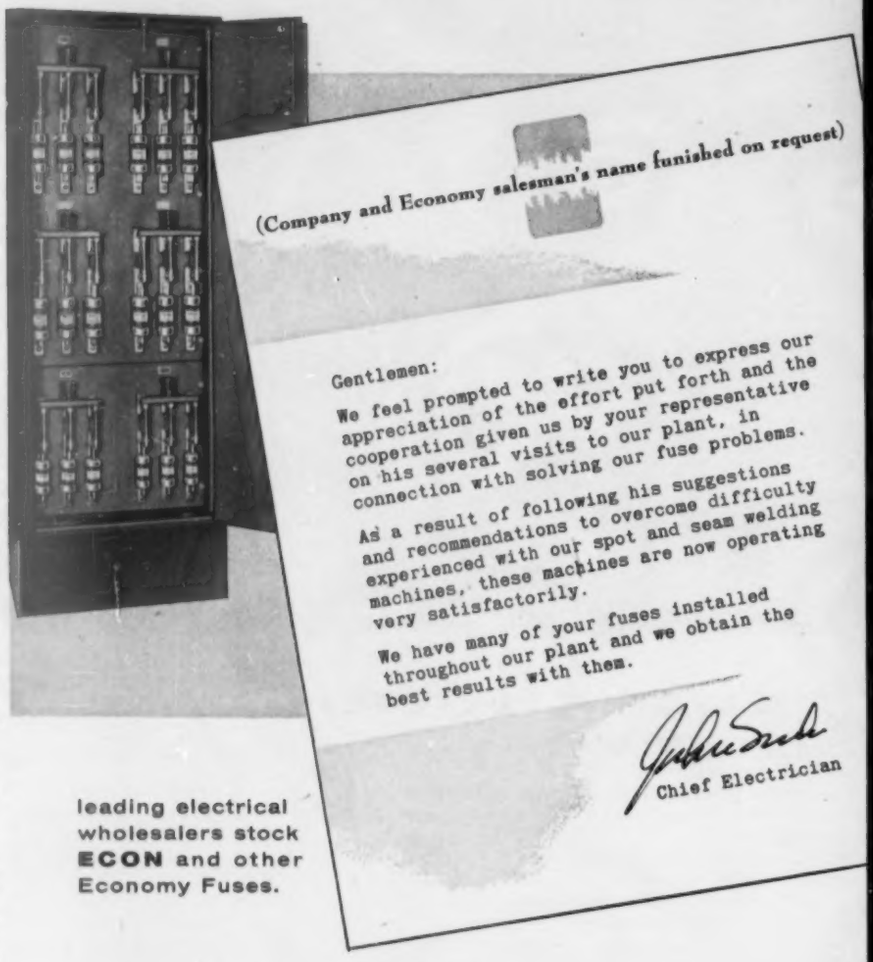

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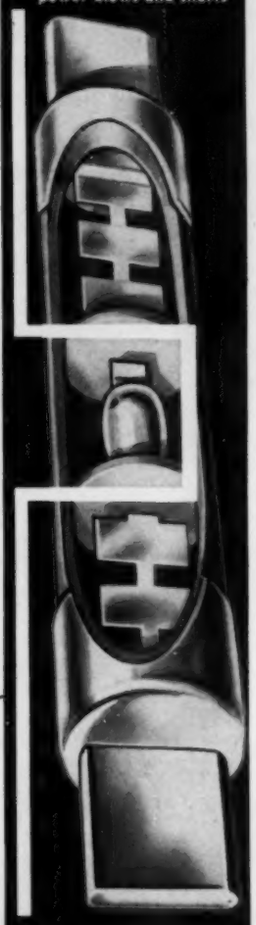

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of single conductor for standard frequencies and for commonly used conductor spacings for various sizes of conductor.

Vector diagram, Fig. 8, illustrates voltage and current relations in a 2-wire, single-phase line. Same diagram may be used for a 3-wire, 3-phase line if the vectors V_t and V_s represent voltages to neutral, instead of line-to-line voltages, and if the IR and IX drops are calculated on a single-conductor basis.

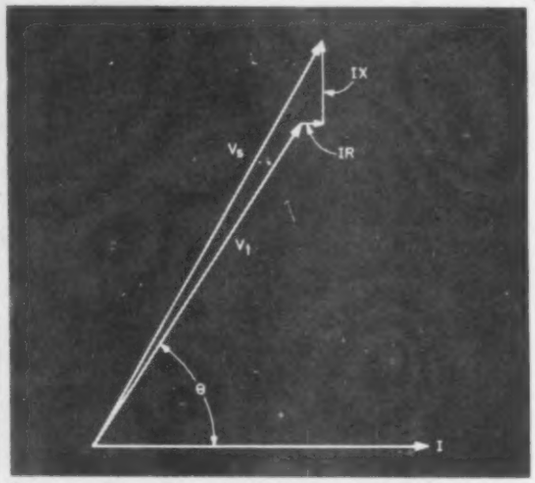

Fig. 8 — Line drop (sum of IR and IX) reduces delivered voltage (V_t) from sending (V_s) voltage.

EXAMPLE: Load of 100 kw at 2300 volts, 3-phase, 60 cps is delivered to a factory 3 miles from a substation. Power factor of the load averages 86.6 percent, lagging. If No. 2/0 stranded conductor is used with a spacing of 36 inches, calculate voltage required at substation end of the line and the power loss in the line.

$$I = \frac{(100)\ (1000)}{(3)^{1/2}\ (2300)\ (0.866)} = 29 \text{ amperes}$$

Since R from table $= 0.0811$ ohms/1000 ft

R per conductor $= (0.0811)\ (5.28)\ (3) = 1.285$ ohms

Since X_L from table $= 0.1258$ ohms/1000 ft

X_L per conductor $= (0.1258)\ (5.28)\ (3) = 1.993$ ohms

$IR = (29)\ (1.285) = 37.3$ volts/conductor

$IX = (29)\ (1.993) = 57.8$ volts/conductor

$$\text{Voltage to Neutral} = \frac{2300}{(3)^{1/2}} = 1328 \text{ volts}$$

Hence, referring to the vector diagram, Fig. 8,

$$V_s = \left[[(1328)\ (0.866) + 37.3]^2 + [(1328)\ (0.5) + 57.8]^2 \right]^{1/2} = 1390 \text{ volts to neutral}$$

$(1390)\ (3)^{1/2} = 2404$ volts between line wires at substation.

Power loss in the line

$$= I^2R = \frac{(29)^2\ (1.285)\ (3)}{1000} = 3.25 \text{ kw.}$$

Tailor-made job

. . . starts on page 18

• Five 2000-ampere, 2-pole, drawout breakers for radial feeders.

Excitation was required for the m-g set. As mentioned, consolidation was advisable with the main dc assembly. The excitation bus can be energized through electrically operated air circuit breakers from either main bus or generator leads. Connection to the generator leads is made through a 0.01-ohm current-limiting resistor. This resistor reduces available fault current to the capability of the excitation breaker. Generator field breaker, synchronous-drive-motor field breaker, and field bus supply breaker for synchronous mill motors are included. This affords cable protection as well as equipment protection for these circuits. Machine field supply bus is insulated to provide isolation from the main power bus. In addition to the above construction, the switchgear assembly at Bridgeport Brass is unique in m-g startup control and in ground detection systems.

predetermined startup

M-g set is put into service following a coordinated, sequential operation of controls involving primary switchgear, motor controls, and dc switchgear. Dc field potential for the m-g set's synchronous motor must be provided first. This is accomplished in the following manner:

1) Bus tie breaker is closed, thus energizing main dc power bus in the switchgear assembly.

2) Next, dc excitation bus is energized by closing breaker on the main bus.

3) Next, synchronous motor dc field breaker is closed, as required by remote field control equipment, when the motor is ready to be "locked-in" at synchronous speed.

Generator is subsequently energized and connected to the main bus:

1) Generator field breaker is closed.

2) Next, generator voltage output is adjusted.

3) Next, generator output is connected to the dc excitation bus, through the current-limiting resistor, by closing the generator field bus breaker and opening the main field bus breaker.

4) Next, the dc bus tie breaker can be opened if desired.

5) Next, the 8000-ampere generator breaker is closed.

Excitation bus can be transfered back to the main bus in the event the m-g set is to be taken off the line.

All main radial feeders have test terminals. In addition, bus potential test terminals are provided. These permit field tests with recording instruments and locating system grounds. Bridgeport Brass' system of locating grounds has been used for some 12 years. It is entirely successful when used on either ac or dc circuits.

Essentially, ground fault detection is based on IR drop indication observed while the system is loaded. Individually comparing feeder current variations to corresponding feeder voltage variations determines which feeder circuit is faulted. Identical swings of the test voltmeter and ammeter occur on the faulted feeder.

central control gives remote operation

All instruments, control switches, and indicating lights are centralized, permitting operation and observation of all loads from one position in front of the switchboard. Generator control includes reverse power protection because of parallel operation with other plant generating equipment and possibilities of regenerative power from heavy variable-speed main drive mill motors. No equalizer cable is provided in the bus tie circuit because of anticipated 12- to 14- volt drop at full load.

Channel base drawings were prepared by the manufacturer within two weeks after receiving the order. Engineers completed the layout of the m-g room. Equipment was easily installed upon delivery to the mill without complication. All this was made possible by the ready availability of standard, catalog-listed equipment adroitly applied to a tailor-made requirement.

Cable and bus supply feeders are installed in cable basement, which runs entire length of room.

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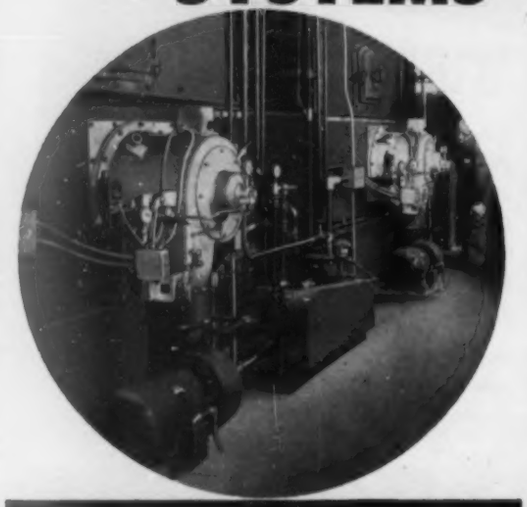

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In brief . . . . American Power Conference

POWER AND the know-how to use it will "take this nation and everyone in it to new heights of productivity and prosperity." Such was the keynote sounded at the recent American Power Conference by R. S. Stevenson, president of Allis-Chalmers. Here are some other highlights of that meeting:

Steam washers for silica removal

E. E. Coulter
Head, Engineering Physics Section
Babcock & Wilcox Co. Research Center

"Advantages to be gained by steam washing depend entirely on the conditions prevalent at the particular installation under consideration: silica content of feedwater, operating pressure, turbine exhaust pressure, and the amount of blowdown that can be tolerated are some of the determining factors. For plants in which it is economically impractical to limit boiler water silica concentrations sufficiently to avoid turbine deposits, the advantages are obvious, for steam washing will eliminate turbine deposits which would otherwise be present.

"For plants which presently use high blowdown rates in order to control turbine deposits, the use of steam washers will allow appreciable reductions in blowdown rates while freedom from turbine deposits is retained. . . . It is evident that turbine deposits due to silica carryover can be controlled by using a steam washer at a saving of more than 80 percent in the blowdown rate required by a standard boiler. It is realized that in some cases other considerations may prohibit such large reductions in blowdown rates."

"Because of the low initial cost and the large savings offered in turbine maintenance and reduced blowdown by steam washing, it is expected that a large percentage of future high-pressure boilers will be so equipped."

Utilization of 300- to 2000-cps power in industry

Vernon C. Geckler, Plant Engineer
New Departure Division
General Motors Corporation

"Outlook in the future for the generating, distributing, and use of high-frequency power will be quite different from that experienced in the last 10 or 15 years. With the exception of special applications where there is a large fixed high-frequency requirement, automation and integrated lines will dictate the use of smaller-size generating units located and sized specifically for a particular production line. Generating units used for these integrated lines will not be a direct-connected unit but a V-belt driven unit on which the belts may be changed to vary the generator speed to gain a different frequency, or variable speed drives will be used to change the frequency.

"This means a greater number of units to maintain but the end results of integration will warrant the application of these small units. In the not-too-distant future, it is very possible that there will be developed an electronic unit which will be sufficiently small in size as to be installed on any one machine tool and will have the ability to vary its frequency within the range requirement of the machine. . . . It will then be possible, through automatic gauging of the grinding wheel size, to increase the speed of the grinding wheel to maintain a constant surface speed per minute required for maximum production."

Comparative study of supercritical and conventional pressures

J. J. Fleischmann
A. H. Gibeling
A. Mergy
Steam Turbine Department

E. R. Miller
Research Division
Allis-Chalmers Mfg. Company

"The supercritical-pressure steam plant represents a major innovation in the production of power. It is logical that the advantages and disadvantages of the supercritical-pressure plant should be determined by comparison with a conventional-pressure steam plant which is a known quantity. This paper presents such a comparison for a specific application, using a 2400-psig 1050/1000-F plant as a base with which to compare two supercritical-pressure plants.

"It is concluded from this study (based on the assumptions that have been made) that the 3500-psig 1050/1050-F cycle is economically justified. As regards the 3500-psig 1150/1050-F cycle, it is apparent that at today's estimated price levels the 1150-F initial temperature is not economically justified on

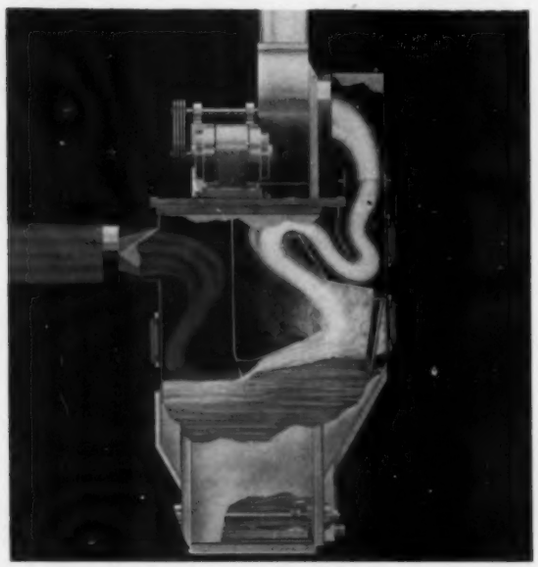
(continues on page 52)

new products

. . . just circle key numbers on READ-N-CIRCLE card on pages 47 or 48

700-Wet dust collector uses venturi principle

Wet dust collector achieves efficient dust transfer from air stream to water by movement of air without mechanical means. Venturi effect atomizes and mixes water



with the air stream. Low-pressure area in venturi throat induces water to enter high-velocity air stream. Mixing of air and water causes transfer of dust particles from air to water. Air, water, and sludge mixture impinges at high velocity on special surface in discharge chamber. Heavy particles, after passing through venturi, sink to bottom of tank as sludge. Washed air then flows to an eliminator section for removing droplets. Clean air is discharged. PANGBORN CORPORATION.

701-Rust inhibiting atmosphere obtained with powder spray and crystals

Highly effective rust inhibitor is now available in crystal and powder form. Inhibitor is easily applied to any steel or aluminum surface to be protected from corrosion. To protect equipment in storage, bagged crystals in porous cotton sacks are hung in strategic locations. Crystals release corrosion protection vapors for a considerable length of time. Reasonably air-tight enclosure is recommended to cut down loss of vapors. Under normal conditions, a 2-ounce bag of crystals will protect equipment in a 30-cu ft enclosed space for 2 to 3 years.

Bagged crystals and bottled powder spray have found wide acceptance. Thorough tests have proved that protection continues as long as any material remains.

Corrosion inhibitor is also packaged in polyethylene spray bottles. Squeezing bottle shoots out a fine mist which diffuses into all corners of hard-to-reach areas. SHELL OIL COMPANY.

702-"New look" fluorescent lamp doubles light output

Major achievement in fluorescent lamp design breaks through the barrier that has restricted amount of light obtainable from fluorescent sources. New design incorporates a series of length-wise grooves along one side of the lamp, greatly increasing permissible wattage input and light output of a given length lamp. Grooves constrict the area within the bulb, reduce the distance radiation has to travel, and permit more radiation to activate phosphor and create light. New lamp development will permit more light per watt and fewer relamping problems with longer time between lamp changes.

Greater light output results also from an increase in lighted tube surface area combined with the higher operating wattage, and more effective use of energy within the tube. Basic length of "power-groove" tube will be 8 feet, but 4- and 6-foot tubes will be available

for special requirements. Lamps are presently designed for 200 watts. GENERAL ELECTRIC COMPANY.

(more new products on page 34)

SOLVE BOILER FEED PUMP PROBLEMS

with better engineered AMERICAN-MARSH CENTRIFUGALS

You can take a big step to prevent departmental headaches—and dark looks from management—with these *better engineered* pumps. Just examine the features of this Multi-stage Type OSMH Boiler Feed and High Pressure Pump, for example. Detail by detail, its construction insures you of *freedom* from maintenance and lubrication troubles, leakage and costly downtime.

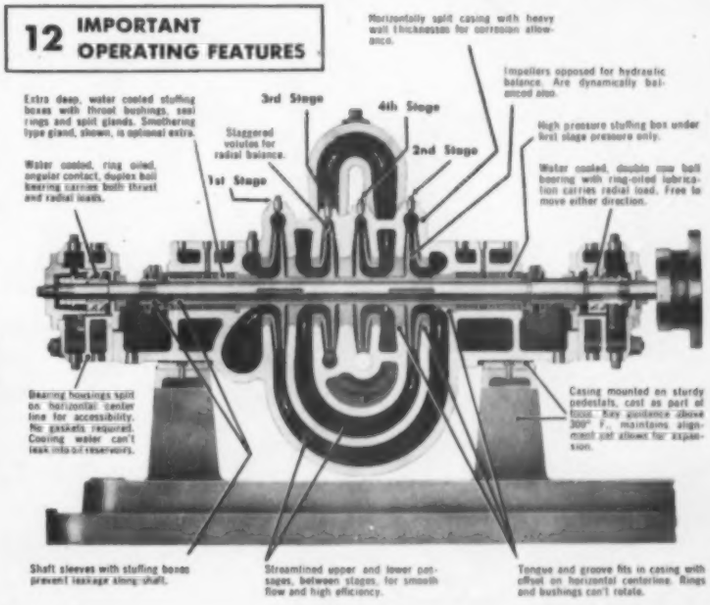
Why not call your A-M representative for full details? He'll assist you ably. Or—

Write Today FOR OSMH BULLETIN 382.

AMERICAN-MARSH PUMPS

BATTLE CREEK MICHIGAN

12 IMPORTANT OPERATING FEATURES


Horizontally split casing with heavy wall thicknesses for corrosion allowance.
Impellers opposed for hydraulic balance. Are dynamically balanced also.
Extra deep, water cooled stuffing boxes with throat bushings, seal rings and split glands. Smothering type gland, shown, is optional extra.
3rd Stage
4th Stage
2nd Stage
1st Stage
Staggered volutes for radial balance.
High pressure stuffing box under first stage pressure only.
Water cooled, ring oiled, angular contact, duplex ball bearing carries both thrust and radial loads.
Water cooled, double row ball bearing with ring-oiled lubrication carries radial load. Free to move either direction.
Bearing housings split on horizontal center line for accessibility. No gaskets required. Casing water can't leak into oil reservoirs.
Casing mounted on sturdy pedestals, cast as part of base. Key assurance above 300° F., maintains alignment yet allows for expansion.
Shaft sleeves with stuffing boxes prevent leakage along shaft.
Streamlined upper and lower passages, between stages, for smooth flow and high efficiency.
Tongue and groove fits in casing with offset on horizontal centerline. Rings and bushings can't rotate.

Pumps and Pumps Only Since 1873

In Canada: American-Marsh Pumps (Canada) Ltd., Stratford, Ont.

CENTRIFUGAL, TURBINE, STEAM AND POWER PUMPS FOR TESTING, PROCESSING, BOILER FEED, FIRE PROTECTION, ETC.

Circle 136 on READ-N-CIRCLE card for more data

new products

. . . starts on page 33

703-Low-headroom deaerator eliminates elevated installations

New deaerators with standard capacities up to 80,000 lb/hr make installations practical in plants where headroom is limited. Design consists of standard steam-jet deaerator with base-mounted pump forming part of the entire unit. Pump suction is connected to large downcomer equipped with an anti-vortex baffle and strainer. High

suction characteristics with this arrangement increase pump discharge pressure to that required at suction of boiler feed pump. Eliminates putting deaerator above boiler feed pump and reduces costly support structure and piping arrangements. Available in four sizes: 17,500-, 35,000-, 50,000-, and 80,000-lb/hr. Provides a practical deaerator for installation in single-story industrial plants, office buildings, and hospitals. WORTHINGTON CORPORATION.

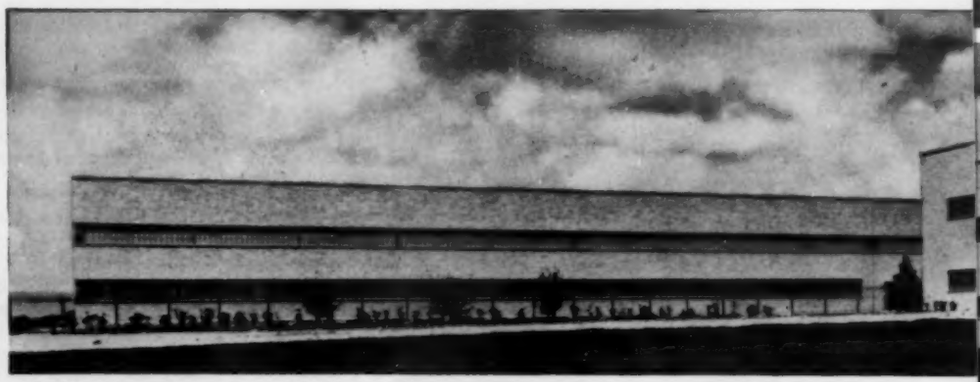
FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on pages 47 or 48.

704-Water-wall furnace gives increased boiler capacity

Forced circulation water-wall boilers offer substantially improved boiler operation — have contributed to increased boiler efficiency. Combination of water-wall with horizontal rotary oil burner eliminates special refractory work and effects substantial savings in boiler operation. Equipment is offered to be incorporated with burners on

HOW WESTERN ELECTRIC GETS PRECISION TEMPERATURE CONTROL FOR ONE ROOM–or ACRES OF ROOM!



New 625,000 sq. ft. Lexington Road Plant of Western Electric Company, Inc., Winston-Salem, N. C.

Western Electric Company, Inc., and Walter Kidde Constructors, architects and engineers, New York; Rowe-Goodin-Jones, Inc., and Piedmont Air Conditioners, Inc., mechanical contractors, both of Durham, N. C.

Johnson Control System Meets Varied Control Needs, Insures Waste-Free Heating, Cooling and Ventilating Performance.

At Western Electric's new Lexington Road Plant, automatic temperature control is a major consideration. The comfort and efficiency of 4,000 employees are directly involved. So are sensitive processing operations. And, in a building this size, the potential savings in heating, cooling and ventilating costs are tremendous.

To satisfy each of these important requirements, Johnson furnished and installed a complete system of automatic temperature and air conditioning control.

MANUFACTURING BUILDING

Actually, the plant consists of two separate structures—a manufacturing building and an office building. The main floor manufacturing area, 620 by 280 feet, is surrounded by an 80-foot periphery partitioned for offices, special process rooms, laboratories, employees' club, cafeteria and locker rooms.

In the general manufacturing area, Johnson Thermostats, Valves, Dampers and related apparatus accurately regulate the operation of 13 large central heating and ventilating systems. Other units serving a partial lower floor are also controlled.

Special process rooms and laboratories are air conditioned. Here the Johnson System rigidly maintains uniform protective temperatures and humidities to safeguard sensitive products and processes.

Office spaces, the cafeteria and employees' club are air conditioned and controlled at ideal comfort levels.

OFFICE BUILDING

The 444-ft. by 103-ft. two-story office building is completely air conditioned. Johnson Air Conditioning Control regulates 12 central air handling units that supply perfectly conditioned air for private offices as well as general offices. Strategically located Johnson Thermostats insure constant comfort, regardless of outdoor conditions, occupancy levels or the heat-producing effects of lighting and office machines.

OPERATING ECONOMIES

Throughout both buildings, Johnson Control produces exactly the desired conditions at a substantial saving in operating costs. The entire installation, like every Johnson System, was engineered to fit the specific control requirements of the plant's particular mechanical equipment. The result is virtually waste-free operation of heating, cooling and ventilating equipment.

In addition, the simplicity and rugged construction of Johnson pneumatic apparatus insure long, trouble-free performance with minimum upkeep.

The techniques and engineering skill applied by Johnson to this modern plant, and countless other buildings of all types and sizes, can also be applied to your control problems. Talk to a Johnson engineer soon. His recommendations are yours without obligation.

JOHNSON CONTROL

SINCE 1885

PLANNING • MANUFACTURING • INSTALLING

R-1051 Static Pressure Indicator-Controller

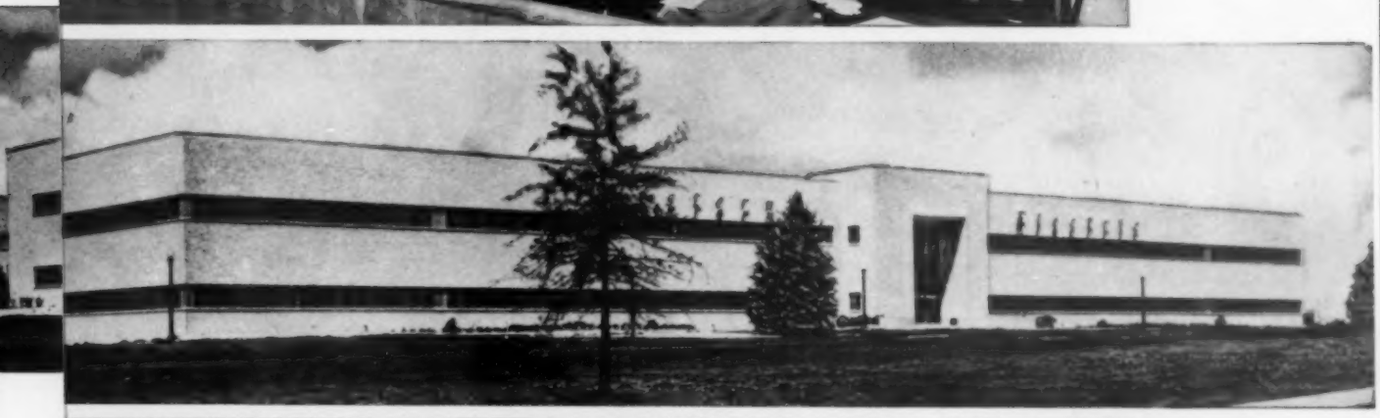
T-800 Remote Bulb Thermostat

T-400 Room Thermostat

V-108 Three-Way Mixing Valve

T-432 Heating-Cooling Thermostat

D-225 Louver Damper



Let JOHNSON SOLVE YOUR CONTROL PROBLEMS

PROCESSING • HEATING • COOLING • HUMIDIFYING
DEHUMIDIFYING • VENTILATING • AIR CONDITIONING

PROCESS CONTROL

Automatic temperature and humidity control for a wide range of manufacturing and industrial process applications. Thermostats, special controllers, valves and dampers applied to tanks, dryers, vats, kettles, curing rooms, coolers, kilns, ovens and other processing equipment.

SPACE CONTROL

Automatic control of room temperature and humidities applied to radiators, radiant heating, unit ventilators, unit heaters and heat delivery ducts. Johnson equipment includes a complete line of thermostats, thermometers, pressure regulators, humidostats, humidifiers, valves, dampers, damper operators, switches, special controllers and related apparatus.

Complete sales, engineering, installation and service facilities are available through 98 direct branch offices in the United States and Canada.

T-1000
Recorder-Controller

V-153 Sylphon
Diaphragm Valve

D-251 Piston
Damper Operator

JOHNSON SERVICE COMPANY

507-LL East Michigan St., Milwaukee 1, Wisc.

☐ Please have a Johnson engineer call on me.
☐ Send your Condensed Catalog of Johnson equipment.

NAME _____ TITLE _____

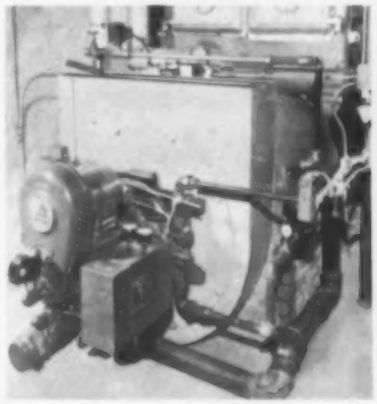
FIRM _____

ADDRESS _____

CITY & STATE _____

Circle 117 on READ-N-CIRCLE card for more data

existing boilers. Advantages of water-wall furnace are: increase boiler capacity 50 percent, improve efficiency 10



percent, reduce combustion chamber maintenance by 33⅓ percent, and improve life expectancy of boiler. PREFERRED UTILITIES MFG. CORP.

705-Cantilever trough supports occupy minimum space

Cantilever cable trough supports permit cable installation and removal without interference from hanger supports. Cantilever arms fasten to wall-

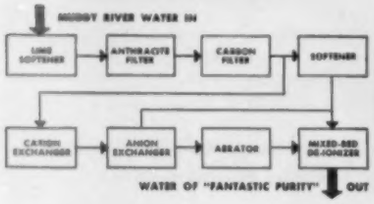
mounted channels through pre-punched holes. Wide number of settings is obtained by locating and spacing pre-punched holes. Support arms are quickly and easily secured to provide continuous support and protection of power and control cables. T. J. COPE DIVISION, RAKIT CORP.

706-Safety gage relieves pressure with thin metal backplate

New gage case construction provides maximum safety on dangerous installations. Thin stainless plate, covering en-

ILLCO-WAY
ionXchange

HOW TO
UN-MUDDY
THE WATERS



This block diagram shows a typical arrangement for a power company steam plant that must draw its boiler feed water from a nearby muddy river. The Lime Softener takes out suspended solids, turbidity, alkalinity, and organic matter; the Anthracite Filter removes any remaining turbidity; the Carbon Filter removes the chlorine; the Softener provides process water; the Cation and Anion Exchangers remove the dissolved solids such as carbonates, sulfates, and chlorides; the Aerator takes out most of the CO_2; and the Mixed-Bed De-Ionizer eliminates the remaining 4 or 5 ppm of solids, silica, and 5 ppm of CO_2 — to produce water of "fantastic purity"

ILLCO-WAY PIONEERS IN
PRACTICAL EXPERIENCE

Illinois Water Treatment Company designs and builds *complete, practical, workable systems* such as that shown above — to operate economically on a cost-reducing basis. This work is based on a wealth of practical knowledge gained through constant experience in the specialized field of ion-exchange, starting from the time that the first workable resins became available.
Remember ILLCO-WAY—foremost in the field of ionXchange.

ILLINOIS WATER TREATMENT CO.
ionXchange
ILLCO-WAY
840 CEDAR ST.
ROCKFORD,
ILLINOIS
NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N.Y.
CANADIAN DIST.: PUMPS & SOFTENERS, LTD. LONDON, ONT.

Circle 147 on READ-N-CIRCLE card

new products

. . . starts on page 33

tire back of case, relieves all explosive pressures. Plate is held firmly in place, eliminating possibility of back-

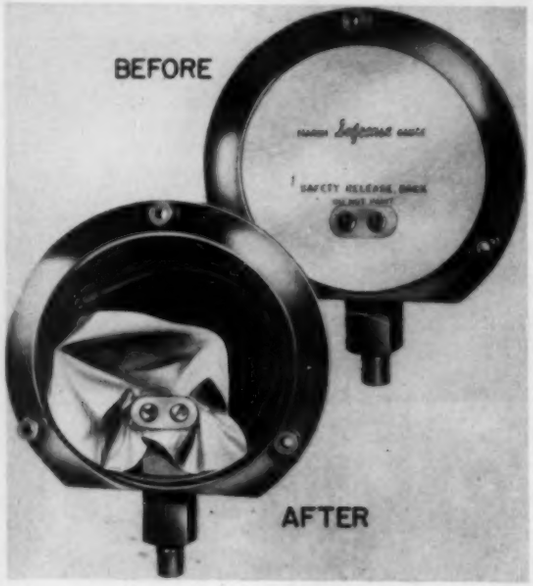
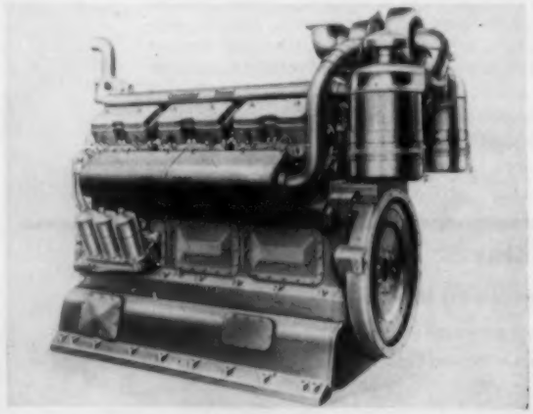


plate leaving case in event of blowout. Case offers maximum protection for industrial gage installations. JAS. B. MARSH CORPORATION.

707-Turbochargers capture exhaust power

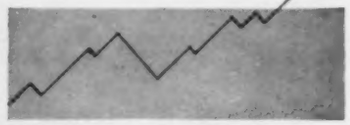
Heavy-duty, V-type, turbocharged engines concentrate maximum power in minimum space. Turbochargers use exhaust gas energy that would otherwise be wasted. New cylinder heads provide more direct path from combustion chamber to exhaust manifold. Improved engine



breathing results in higher efficiency and lower fuel costs. Close-coupled, self-regulating electric generators with top-mounted exciters give simple operation. CATERPILLAR TRACTOR CO.

TO
KEEP
COSTS
DOWN

KEEP
PRODUCTION
UP
WITH



MANZEL
FORCE FEED LUBRICATION
Pressure Application — Exact Amounts — Accurately Timed

Manzel Force Feed Lubricators insure efficient machinery operation by lubricating automatically. No stops for hand oiling — or because of breakdowns caused by faulty lubrication. They

quickly pay for themselves through savings in down time, labor and lubricants.

These sturdy, dependable lubricators can be installed on new or existing equipment. Write for details.

Manzel
Professionally qualified engineering representatives throughout the country.
DIVISION OF
HOUDAILLE-HERSHEY CORP.
320 BABCOCK ST., BUFFALO 10, N. Y.

Circle 102 on READ-N-CIRCLE card for more data

Jerguson

TRUSCALE

Remote Reading Gages

Available with Explosion Proof Illuminators.

Full 180° Visibility
Accuracy to ½ of 1%

You get full 180° visibility with the new Jerguson Truscale Gages with the Convex Scale. Scale markings are directly on the convex face and the indicator goes clear around the convex surface. You can bring your liquid level down to the control room floor, or other remote point . . . and can see it from anywhere in the room . . . can check a whole line-up of Truscales with one look from any point.

Truscale is really accurate too . . . sensitive to ½ of 1% of scale reading. Simple trouble-free construction. Available with signal horns, lights and up to six repeaters for other auxiliary points.

New design boiler water gage gives maximum visibility

Jerguson's unique offset single piece gage chamber gives you more inches of visibility with no blind spots. Special valve with horizontal loop keeps the strain off the gage under varying conditions of expansion and contraction.

Send for complete data on Jerguson Convex Scale Truscales . . . and Boiler Water Gages.

JERGUSON

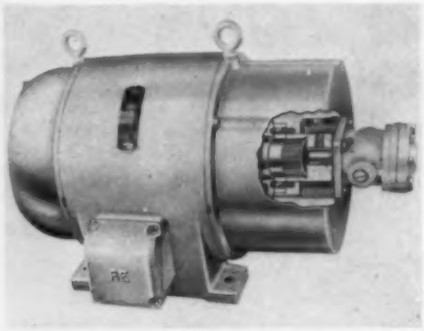
Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Offices in Major Cities
Bailey Meters & Controls, Ltd., London, Eng.
Controle Bailey, Paris, France

Circle 119 on READ-N-CIRCLE card

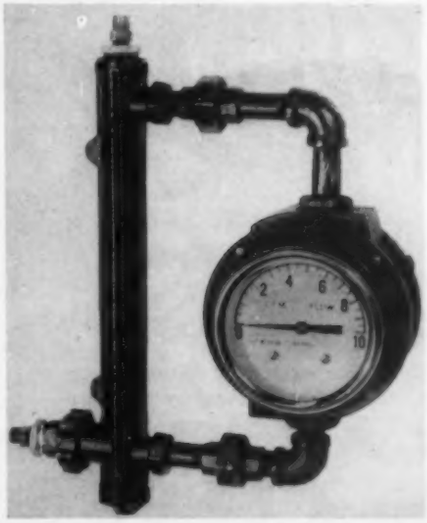
708-Spline-coupled motor eliminates alignment problems

Spline-coupled hydraulic pump motors can be hooked up without adapter and alignment problems. Installation time is reduced to approximately 1/10 as long as conventional jobs. Motors are available in ratings from 15 through 40 horsepower in frame sizes 324U and 326U. Can be supplied for either single- or double-end pump installation. Couplings result in compact, single-purchase installations. REULAND ELECTRIC COMPANY.



709-Efficient, vane-type flowmeter for air and gas flow

Simplified, vane-type flowmeter is now available for air or gas flow measurements.



Flowmeter is designed for constant pressure drop across the meter. May be used for indicating, controling, signal alarm, safety shutoff, and sequence starting or shutdown.

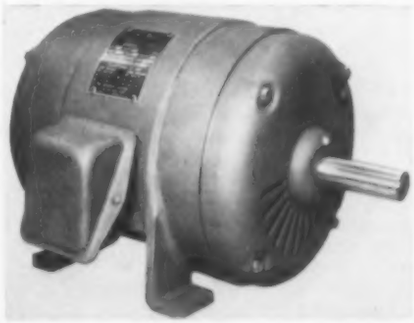
As flow increases, area between end of the vane and the flexible spline in the meter body increases. This increase approximates the law of squares and gives pointer stability and easy-to-read scale. Simple adjustments provide quick calibration for different gas densities. Meter cannot be damaged by overrange flow or excessive pressure. Since flowmeter is calibrated against gravity, no zero adjustment is necessary. Springs, bellows, and diaphragms are eliminated. SCULLY-JONES AND COMPANY.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on pages 47 or 48.

710-Extruded plastic insulation seals motor windings

Extruded plastic insulation that provides sealed-in protection is now used for motor windings. Motor stator is placed in a die and liquid plastic resin is extruded under heat and pressure around the stator windings. This results in a motor winding completely encased in a rigid, tough, and durable mass. Stator winding is encased in a continuous, homogeneous, insulating material of high dielectric strength and corrosion resistance, and is suitable for all industrial applications. Plastic insulation demonstrates exceptional resistance to chemical action, humidity, abrasive dust, and oil vapor. Open-type motor can be used to replace totally enclosed units in many applications.



Plastic provides a medium for evenly conducting heat from every wire. Windings are permanently anchored, thus enabling motor to withstand vibration to a greater degree without failure than ever before. THE LINCOLN ELECTRIC COMPANY.

711-Voltage booster is portable

Portable electric power unit is designed to deliver additional voltage for portable power tools. Equipment has voltmeter for checking output voltage. A 5-position voltage increase switch controls output voltage. Each position gives a 10-volt increase in voltage output. Cord with No. 12 conductor can be used under almost every operating condition from power source to voltage booster — up to 1000 feet. PORTOPOWER DIVISION.

Kalamazoo

offers 3 bulletins to help you plan STORAGE BINS, TANKS, CHESTS for Bulk Materials in Process or Storage

1

Shows cross sections and details of Kalamazoo Industrial Storage Bin construction plus advantages of maintenance-free Kalamazoo Vitrified Glazed Tile. Application photos.

2

Eight pages describing round and rectangular Wood Tanks, Special Vats, Flumes, Ducts and Frost-Proof Wood Boxing, used in processing and bulk storage. Construction details, numerous examples.

3

Illustrates Kalamazoo Split Tile and Unit Tile for straight or curved tanks and chests. Also Tile Lining for old or new tanks, pits. Applications shown.

Fill out and mail coupon today.

CHECK BULLETINS YOU WANT—
Kalamazoo TANK AND SILO CO.
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☐ 1—Tile Storage Bins, Bul. 1153-B
☐ 2—Wood Tanks, Bul. 655-W
☐ 3—Tile Tanks, Chests, Bul. 1055-T

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Kalamazoo | **TANK & SILO CO.**

Circle 132 on READ-N-CIRCLE card

More Reliable AIR CONDITIONING

...for your process or the testing or protection of your products and materials...with EXACT moisture control at all times of the year

Assembling Electronic Parts

Drying Industrial Materials

This NIAGARA METHOD gives you the *most effective* air conditioning because its cooling and heating functions are completely separated from the addition or removal of moisture. Therefore, you always get a precise result. You can reach and hold any condition, or vary it as you wish, without having to rely on moisture-sensitive instruments.

It is *easy to take care of.* All parts of the equipment are accessible. The control circuits are simple. It removes moisture by absorption, yet there are no salts or solids or solutions of solids to be handled.

It is *inexpensive to operate.* It does a large amount of work in a small space. At normal operating temperatures, since it absorbs moisture directly without refrigerating below the required dew point, there is no re-heating.

Write for full information; ask for Bulletin 112. Address Dept. I.P.

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
District Engineers in Principal Cities of U.S. and Canada

Circle 105 on READ-N-CIRCLE card

new bulletins

. . . just circle key numbers on READ-N-CIRCLE card on pages 47 or 48.

400-Color code identifies pipe for safety

Reference chart outlines accepted use of color in safety practices for protecting property and personnel. May be posted in shop for quick, easy reference. Includes recommendations for pipeline identification by uniform safety color code. Lists five main classes and colors to identify each class: safe, dangerous, protective, valuable, and fire protective. Describes use of basic colors supplemented by symbols to make equipment identification easily remembered. THE ARCO COMPANY.

401-Need weather-protected motors?

Weather-protected motors, both horizontal and vertical, in capacities of 250 hp and above are described in Bulletin 05B7874B. Includes sectional view of a typical 700-hp, 2300-volt, 1185-rpm squirrel-cage induction motor. Describes construction features including screens and filters, space heaters, insulation, accessories, bearings, and mountings. Six pages. ALLIS-CHALMERS MANUFACTURING CO.

402-Bulk materials handling handbook

Data on materials handling equipment including conveyors, chains, feeders, elevators, hoppers, and drives is contained in Bulletin 955. Engineering data, dimension drawings, and illustrations describe complete line of equipment. Contains information on equipment to satisfy all your coal handling requirements. Thirty-four pages. MCNALLY PITTSBURG MANUFACTURING CORPORATION.

403-How to choose electric tape

How to choose the electric tape best suited for insulating and protecting applications in construction and maintenance is described in Bulletin 74-10-50. Lists recommendatons and performance specifications of plastic, friction, rubber, and vinyl tapes. Colored vinyl tapes in nine colors make color-coding and identification easy. Contains charts giving properties and characteristics of each tape. Twelve pages. JOHNS-MANVILLE.

404-Self-aligning roller bearing data

Specifications on all models of self-aligning roller bearings in shaft sizes from ¾- to 7-inch are described in Catalog 55. Includes engineering data on load rating tables, bearing seals, and gives exploded views for parts identification. Illustrations show typical applications with recommendations for the proper bearing for any installation. A recommended addition to your library. Seventy-two pages. CHAIN BELT COMPANY.

405-Crane selection handbook

Handbook M-100 discusses all types of electric overhead traveling cranes and materials handling equipment. Includes information on latest developments in crane manufacture, classification of cranes, runways, electric equipment, and engineering data for crane selection. Forty pages. DOMINION BRIDGE CO. LTD.

406-Read about visual alarm systems

Here is an easy-to-understand, nontechnical discussion of visual alarm systems and how they can be used in your plant. Bulletin lists pertinent data and schematic wiring diagrams, for every type of annunciator. Includes installation dimensions for single or multiple units and for the complete line of accessories. Thirty-two pages. THE AUTOCALL COMPANY.

407-Welding procedure data chart

Welding procedures and recommendations for arc welding various tubing steels are contained in data chart TDC-155A. In addition to indicating proper electrodes, it provides information about preheating and post-welding heat treatments. A valuable condensed chart for all who weld stainless and alloy steels in tubing and other forms. THE BABCOCK & WILCOX COMPANY.

408-How to select industrial signals

Three major factors in signal selection are discussed in this bulletin: purpose of signal; areas to be covered; and noise levels to be overcome. Discusses general alarm, start and dismissal, coding or paging, and danger signals, for outdoor and indoor areas. Illustrations show recommendations for a typical plant. Condensed chart shows range for each signal type. Eight pages. FEDERAL SIGN & SIGNAL CORPORATION.

409-Automatic temperature control

Automatic control systems — including electronic, hydraulic, pneumatic, and electro-mechanical—are described in Bulletin D-31. Describes single-source responsibility for entire system including design, equip-

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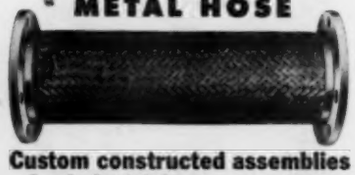

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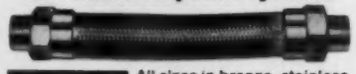

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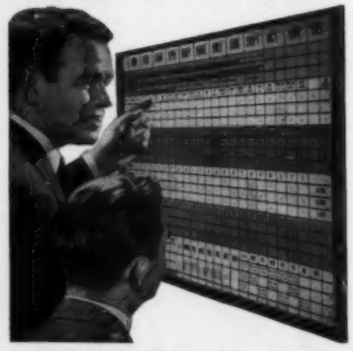

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ment, and startup. Lists specifications and recommendations for complete equipment line including time controls, motorized valves, counters, and electronic contactors. Twenty pages. AUTOMATIC TEMPERATURE CONTROL COMPANY, INC.

410-Teflon packing and gasket data

Advantages of Teflon over other packing for many applications are discussed in this bulletin. Describes envelope, solid, and stuffing box gaskets; braided, plastic, and other types of valve stem packing. Contains data on chemical, electric, and mechanical properties. Lists typical applications. Particular reference is made to precautions in combatting toxic effect of heated Teflon. Eight pages. RAYBESTOS-MANHATTAN, INC.

411-Cable troughs are flexible

Cable troughs engineered for easy installation are described in this bulletin. Contains installation instructions, load charts, accessory items, typical installations, and list of distributors. Discusses how simple solutions to problems of change of direction or elevation can be solved with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, and crosses. Twelve pages. THE GLOBE COMPANY.

412-Heat exchanger is multi-purpose

Longitudinally finned tube heat exchangers for handling a variety of fluids are described in Bulletin 1401. Includes heat exchanger recommendations for heating, cooling, condensing, and heat exchange services. Lists specifications and dimensions for all types. Illustrations show many typical installations. Results obtained are described in field service reports. Twenty pages. THE GRISCOM-RUSSELL COMPANY.

413-Eleven ways to save drafting time

Bulletin discusses 11 specific ways to use intermediates with time-saving techniques clearly illustrated. Covers topics of scissor editing, masking, block out method, and successive additions and pre-printing. Techniques can be applied to various print making methods, such as: moist-developed process, ammonia process, blueprint process, sepia negatives, and reproduction cloths. FREDERICK POST COMPANY.

414-Clean boilers give better operation

Complete water treating service from initial survey to operating report forms is discussed in this bulletin. Describes treatment that stops scale, corrosion, foaming, and carryover by using correct treating com-

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new bulletins

. . . starts on page 38

pounds. Describes portable water test kit for field use. Gives quick, accurate test of water samples without knowledge of chemistry or involved calculations. Four pages. NORTH AMERICAN MOGUL PRODUCTS COMPANY.

415-Selecting heat exchanger tubing?

Engineering data, specifications, and application recommendations for condenser and heat exchanger tubing, plates tube sheets, and baffles are contained in Bulletin B-2. Separate section discusses corrosion factors in condenser tube service. Includes tables giving weights in lb/linear ft, theoretical carrying capacity, physical properties, and tensile strength. A recommended addition to the library of all power services engineers. Forty-four pages. THE AMERICAN BRASS COMPANY.

416-Switches insure safe operation

Bulletin 856 contains information on full line of mercury switches and controls. Lists mercury switch controls for temperature, pressure, oil burner controls, stoker, liquid-level, and boiler feedwater pumps. Gives advantages of mercury switches, such as visible contact, elimination of contract wear, and seal from hazardous atmospheres, dirt, and corrosion. Fifty-two pages. THE MERCOID CORPORATION.

417-Generate your own inert gas

Inert gas generators that provide high-pressure gas for protection against fire and explosion are discussed in Bulletin IGG-155. Describes constant gas analyzer, controlable output, and protective devices. Line diagram shows typical installation for a controlled, variable-range, high-pressure inert gas system. Ten pages. ROOTS-CONNERSVILLE BLOWER DIVISION, DRESSER INDUSTRIES, INC.

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418-Centrifugal pumps that won't clog

Bulletin 121A describes non-clog pumps for handling solids in suspension. Includes vertical, horizontal, and close-coupled types. Recommended for handling industrial process liquids and wastes, water supplies, and drainage. Capacity chart lists pumps with capacities from 50 to 7000 gpm. Eight pages. AURORA PUMP DIVISION, NEW YORK AIR BRAKE COMPANY.

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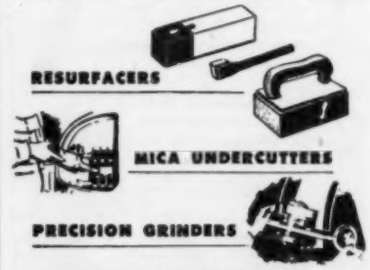

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AIR CLEANING EQUIPMENT

502-Improved electrostatic dust control

"Dust and Fume Control," 11-page Bulletin G406, tells of the improvements and refinements that have been made in electrostatic precipitation since the first Cottrell precipitator was erected. Also included are background material and illustrations of the Multiclone mechanical dust collector, the CMP unit—a combination Multiclone and Cottrell unit, Dualaire dust collector, and Holo-Flite processor. WESTERN PRECIPITATION CORP.

AIR CONDITIONING, HEATING, VENTILATING

504-Air-conditioning history

Development of air-conditioning units from earliest attempts to present-day techniques are disscussed in Booklet "Why RK?". Booklet compares three air-conditioning installations as to savings in initial and maintenance costs, on-the-site labor, materials, space, and year-round use. Diagrams show application of RK air-conditioning equipment in 12 different businesses. Excellent primer for basic understanding of air conditioning. Thirty-six pages. UNITED STATES AIR CONDITIONING CORPORATION.

BOILERS and BOILER ACCESSORIES

505-Steam cost calculator

Made of heavy board, this Steam Cost Calculator will enable you to read directly cost of steam per horsepower for installations using oil, coal, or gas. It also gives a direct reading of system efficiency. HAPMAN DUTTON CO.

507-Handbook on startup

Handbook covers washing out new boiler, putting it in operation, handling in service, firing methods, and shut down. Includes big section of everyday engineering data. Forty-eight pages. TITUSVILLE IRON WORKS CO.

508-Boiler instrument handbook

Boiler instruments to cover every phase of operation from water treatment to dust removal are contained in Bulletin GSP-901. Illustrations and text are combined to make this bulletin a necessity for engineers interested in boiler and steam problems. Twenty-six pages. HAGAN CORPORATION.

BUILDING CONSTRUCTION, MATERIALS

510-How to build better masonry

Recommended practice covering materials, proportioning, mixing, and laying of units is offered in Bulletin WP6.5535M. Three essentials to better masonry and four essentials to better mortar are given with quantity reference tables. Twenty-four pages. UNIVERSAL ATLAS CEMENT COMPANY.

CORROSION CONTROL

514-How to run rust ragged

How to get the most out of your rust-prevention maintenance painting is described in Bulletin 255. Includes outline for maintenance painting including surface preparation, paint mixing, application technique, and drying time. Lists advantages for use on wood, concrete, metal, and plaster. Multicolor illustrations depict laboratory tests as well as complete line of colors and numerous in-use examples. A recommended bulletin for all engineers concerned with maintenance painting. Twenty-eight pages. RUST-OLEUM CORPORATION.

516-Pocket-size corrosion data

Unique, pocket-size folder describes 11 scale and corrosion control compounds. Contains recommendations for usage, including correct proportions. Compounds are available for scale and corrosion control, oxygen removal, pH adjustment, algae control, and for all problems encountered in water control. D. W. HAERING & CO., INC.

ELECTRIC DISTRIBUTION

521-Steel conduit manual

Description and specifications of rigid conduit in sizes from ½- to 6-inch nominal id are included in Bulletin 18-255. Contains data on size, weight, and physical properties of five types of steel conduit. Data tables list the number of conductors for different AWG or MCM specifications that can be run in

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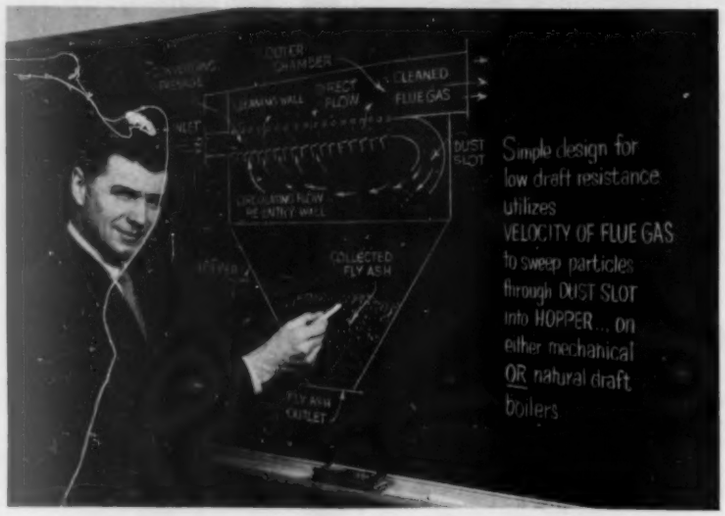
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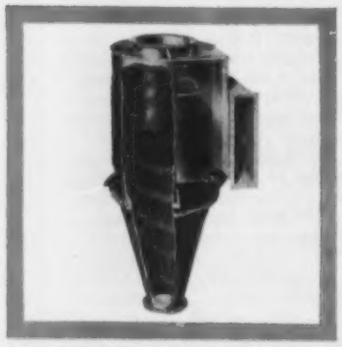

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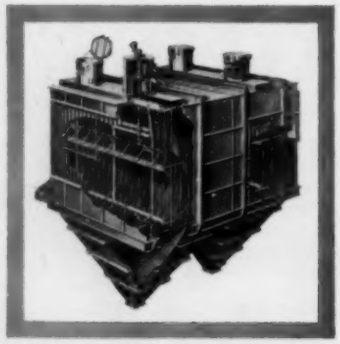

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different conduit sizes. Also lists advantages of 19 percent easier bending and 14 percent easier wire pulling through conduit. Eighteen pages. GENERAL ELECTRIC COMPANY.

522-Cable selection chart

Comprehensive selection chart for insulated electric cable included in Bulletin 1096. Lists minimum standard industry specification requirements for each insulation and covering. Describes trade name insulations, their limitations, and correct installation methods. Excellent reference for engineers concerned with purchase and use of electrical cable. Sixteen pages. THE OKONITE COMPANY.

523-Transformer engineering data

Engineering manual on distribution transformers, Bulletin 136, contains performance data charts, dimensions, and weights for single- and three-phase transformers, both oil- and askarel-filled. Includes data on terminal details, arrangements, and testing and inspection practices. Sixteen pages. R. E. UPTEGRAFF MANUFACTURING COMPANY.

524-Electric conductor data

Engineering data on laboratory tests and service records covering performance of electrical conductors are contained in engineering Bulletin EB-27. Operating temperatures, dielectric strength, aging, insulation resistance, moisture absorption, and power factor are discussed in detail. Descriptions of the many installation procedures are also included. ANACONDA WIRE & CABLE COMPANY.

525-Panelboard engineering data

Engineering data for panelboard selection and installation are contained in Bulletin 3-205. Illustrations, engineering drawings, and specifications describe the features and construction of each panelboard and give recommendations for application. Includes data on Underwriters' Laboratory transformer connection requirements, and circuit breaker characteristics. Seventy-five pages. FEDERAL PACIFIC ELECTRIC COMPANY.

527-How to choose circuit breakers

Essential information on selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections make extensive use of charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Also included are the latest prices, dimensions, and ordering instructions—arranged and indexed to reduce reference time and eliminate errors. Sixty pages. I-T-E CIRCUIT BREAKER COMPANY.

ELECTRIC UTILIZATION

530-Handy pocket charts

Charts for wire gauge and temperature conversion are available in a pocket-size Bulletin No. GEZ-1510. The bulletin is printed on durable plastic material in large easy-to-read type. GENERAL ELECTRIC COMPANY.

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FUELS and FIRING EQUIPMENT

532-Industrial heating handbook

New handbook provides plant engineers with basic concepts of industrial heat processing and heat control. Pruned of technical language, the handbook goes from a discussion of heat-to-fuel cost comparisons to design elements. Common formulas used in calculating heat and oven requirements are included. Bulletin 555 is a refresher course in process heating, and is a must for all plant engineers. Twenty pages. MICHIGAN OVEN COMPANY.

HEAT EXCHANGERS

533-Heat-transfer selection guide

Engineering data, dimensional drawings, and capacities for easy selection of the more commonly used types of heat-transfer equipment are contained in Bulletin 31. Additional data is also included for booster heaters, instantaneous water heaters, condensate coolers, and converters. Recommendations for installations in industrial, chemical, and process industries are given. Twelve pages. BUXTON MANUFACTURING CO.

INSTRUMENTS and CONTROLS

534-All-purpose rotameter handbook

Illustrations and text in this catalog describe complete line of indicating, recording, controlling, and integrating flowmeters for liquid and gas measurement. Contains dimensional installation diagrams. Capacities; corrosion-resistant properties; and unique features of full-view, armored purge meters, and research rotameter equipment are given. Excellent reference catalog for engineers concerned with flow measurement. Sixty-eight pages. BROOKS ROTAMETER COMPANY.

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535-Pocket-size thermocouple manual

Bulletin F 7255 is a convenient pocket-size reference manual for instrument men and engineers. Gives thermocouple temperature-millivolt equivalents. Temperatures are expressed on the International Temperature Scale of 1948, and electromotive force is expressed in absolute units. WHEELCO INSTRUMENTS DIVISION, BARBER COLMAN COMPANY.

536-Temperature conversion chart

Handy two-color chart converts degrees Fahrenheit to degrees Centigrade over the range from −400 to +4000 degrees. It also shows temperature ranges of different sensing elements. Thermocouples, resistance bulbs, and radiation heads are shown, with recommendations for installation and maximum limits for both continuous and intermittent service. A valuable reference chart. THERMO ELECTRIC CO., INC.

537-How to measure water vapor

Measurement of water vapor in air and other gases is informatively discussed in Bulletin 224. Discusses gravimetric, dewpoint, and wet- and dry-bulb methods, as well as some less common and even experimental methods. An easy-to-understand discussion of moisture measurement, causes, and effects. Twelve pages. PITTSBURGH LECTRODRYER CORPORATION.

538-Test with tong-type ammeters

How to obtain accurate ac and dc current measurements safely and without interrupting circuit is discussed in Bulletin TT-5515. Tong-type ammeters measure both ac and dc up to 1000 amperes with fourteen scale ranges. Test ammeters can be used safely for measuring current on lines up to 2300 volts. Includes information on voltage attachment that permits simultaneous readings of both voltage and current. Ammeter is priced within the range of portable test equipment for all power services engineers. Eight pages. COLUMBIA ELECTRIC MFG. CO.

MAINTENANCE ITEMS

543-Stainless steel data book

This new data book is a must for every engineer's library. Design and dimensional information on flange drilling templates, flange and ring-joint facings, stainless steel pipe, pipe threads, pressure-temperature ratings and conversion factors, resistance to fluid flow, hardness conversion tables, physical, and mechanical properties of stainless steel are covered. Detailed materials selection chart for more than 300 corrosive solutions is included. Sixteen pages. COOPER ALLOY CORPORATION.

544-Handbook on specialty steels

Distinctive characteristics of a broad range of special purpose steels in terms of end use are given in this comprehensive handbook. It briefly summarizes tool and die steels, stainless steels, silicon and high-nickel electrical alloys, special purpose alloy steels, valve, heat-resisting and super-alloy steels, tubing and pipe, and fine wire. Will help to match the proper steel to the job. Thirty-two pages. THE CARPENTER STEEL COMPANY.

MECHANICAL POWER TRANSMISSION

545-Rubber hose, belting manual

Need a ready-reference on rubber hose, belting, and packing? Catalog is fully illustrated, contains a wealth of information on sizes, weights, applications, and construction features for all users of industrial or mechanical rubber goods. Lists data on rubber hose from ¼ to 15 inch id. Contains belting data for materials handling applications in all sizes to meet your needs. An excellent bulletin for the library of all engineers. Seventy-two pages. HAMILTON RUBBER MANUFACTURING COMPANY.

547-What is dynamic unbalance?

The answer to this question and the answer to how to balance rotating parts weighing from four ounces to eight tons is contained in Bulletin BP-7. Tells how dynamic balancing reduces bearing wear, eliminates noise and vibration, and improves finished product performance and efficiency. Twenty-four pages. BEAR MANUFACTURING CO.

548-Conveyor belt slide rule kit

Two slide rules that cut the time required for designing a conveyor belt installation from three hours to ten minutes are now available. They are part of a conveyor belt construction kit. One is a horsepower calculator.

(more free bulletins on page 44)

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The other is a carcass selector. They incorporate the engineering data contained in a 40-page conveyor belting notebook. UNITED STATES RUBBER COMPANY.

PIPING, TUBING, and HOSE

549-Plastic pipe handbook

Threaded- and socket-type fittings and flanges in both normal and high-impact grades are included in this bulletin. Includes installation information, pressure-temperature charts, chemical resistance tables, and other reference data. Polyvinyl chloride pipe material is resistant to corrosion, inert, non-toxic, and light weight. TUBE TURNS PLASTICS, INC.

550-Piping flexibility analysis

Bulletin tells how to reduce cost of materials, design, and construction of processing and power piping systems. Includes development and solution of simultaneous equations for determining forces and moments in piping systems. Solves typical piping stress problem — high-temperature reheat system for utility central station — by both general analytical method and model test. Analyses permit specifications closer to the theoretically perfect pipe design. Twelve pages. FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY.

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PUMPING EQUIPMENT

551-How to figure pump heads

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How to install and take care of power pumps is visually demonstrated in Bulletin G-2198. Explains details of foundations, suction conditions, piping support, cleaning, alignment, lubrication, and testing. Includes maintenance information on initial and replacement packing, packing adjustment, common types of pump valves, and tips on trouble-shooting. A guide on power pumps for engineers and operating men concerned with pump installation and operation. Twenty pages. WORTHINGTON CORP.

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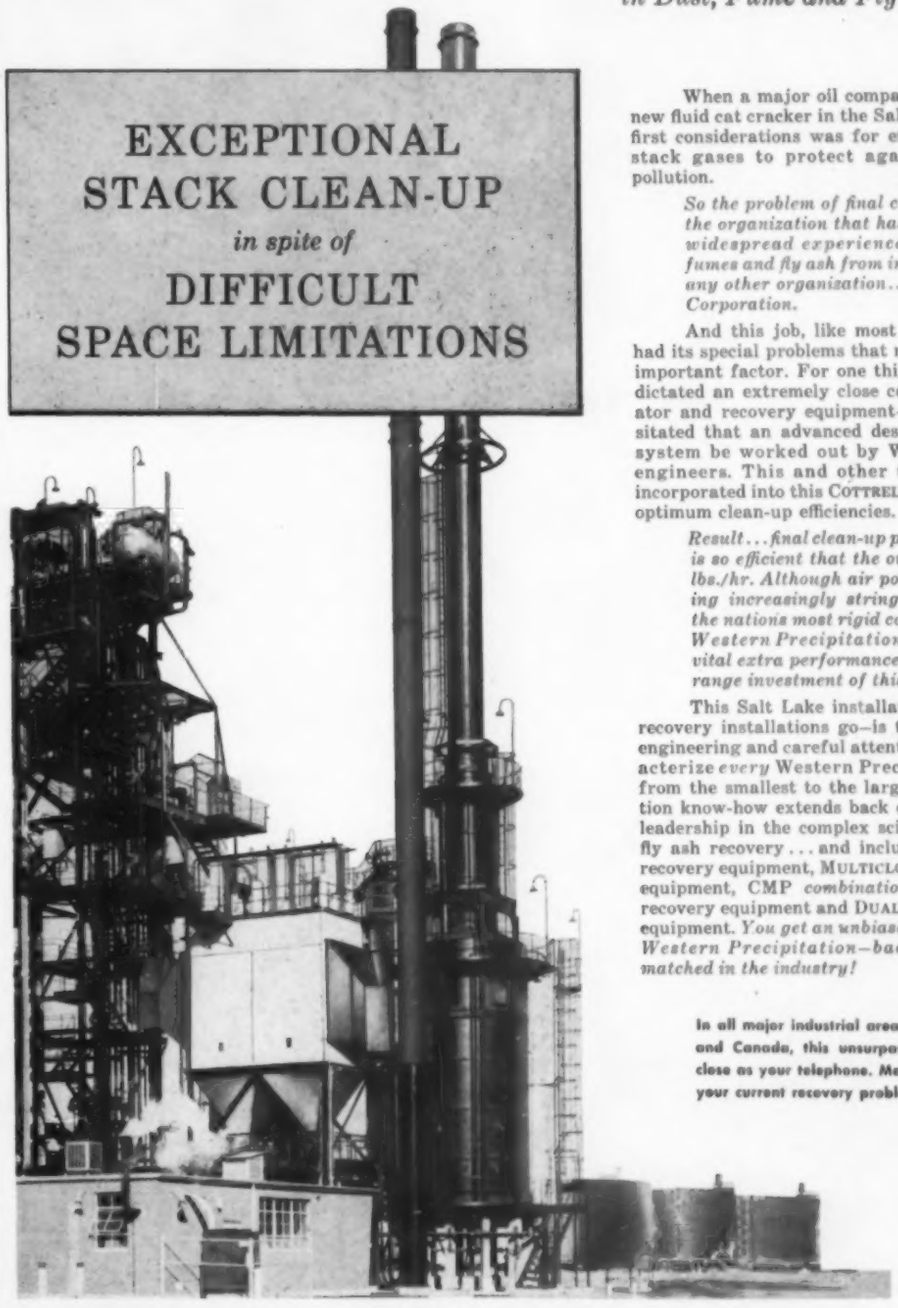

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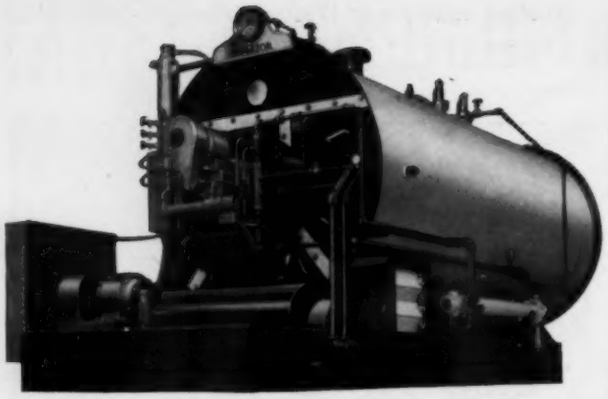

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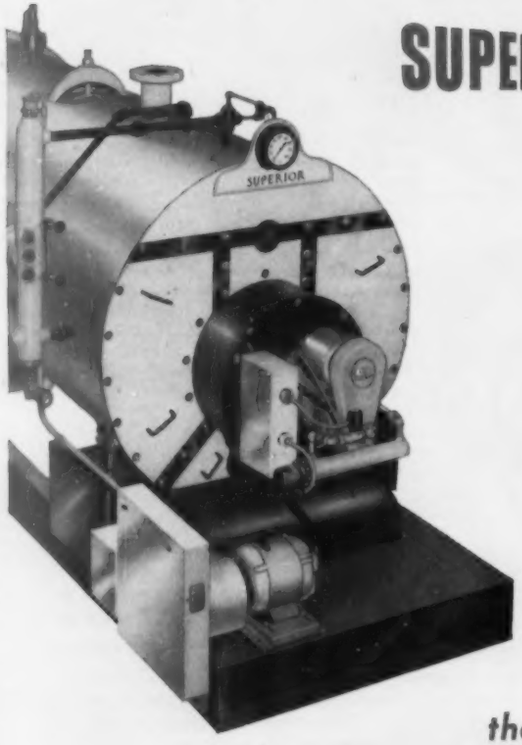

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names make news

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Elgin Softener Corporation promotes **Ben F. Willey** to newly created post of director of technical information. Willey will coordinate technical aspects of water conditioning with all phases of industrial sales division.

Rhinehart

Reid

National Society of Professional Engineers elects **Robert J. Rhinehart** president. Rhinehart is division superintendent in charge of engineering construction, operation, and maintenance for the Arkansas Power & Light Company. NSPE also elects six regional vice presidents and a treasurer. Elected are: **Allen H. Kidder,** testing division executive for Philadelphia Electric Company, Northeastern Region; **Warner Howe,** consulting engineer, Southeastern Region; **Clark A. Dunn,** professor of civil engineering, Oklahoma Institute of Technology, Southwestern Region; **Lindley R. Durkee,** area representative for Housing and Home Finance Agency, Western Region; **Garvin H. Dyer,** manager and chief engineer, Independence Division, Missouri Water Company, North Central Region; **Harry G. Kennedy,** executive secretary Kanawha Coal Operators' Association, Central Region; **Russell B. Allen,** professor of civil engineering, University of Maryland, treasurer.

American Society of Mechanical Engineers names **John Thomas Reid** research manager. Reid's duties will include staff service for ASME's research committees, coordination and assistance in fund-raising for research projects, and liaison with the Engineering Foundation and the National Research Council.

Darling Valve & Manufacturing Co. elects officers: **Charles H. Schreyer,** president; **Carl H. Simon,** vice president and general manager; **Dick F. Sable,** general sales manager; **Thomas C. Jester,** chief engineer; and **James N. Elwood,** manager in charge of manufacturing.

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All sizes to fit your gages
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Save up to $500 a year per truck
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NATIONAL AIROIL
Oil Burners
OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO
Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
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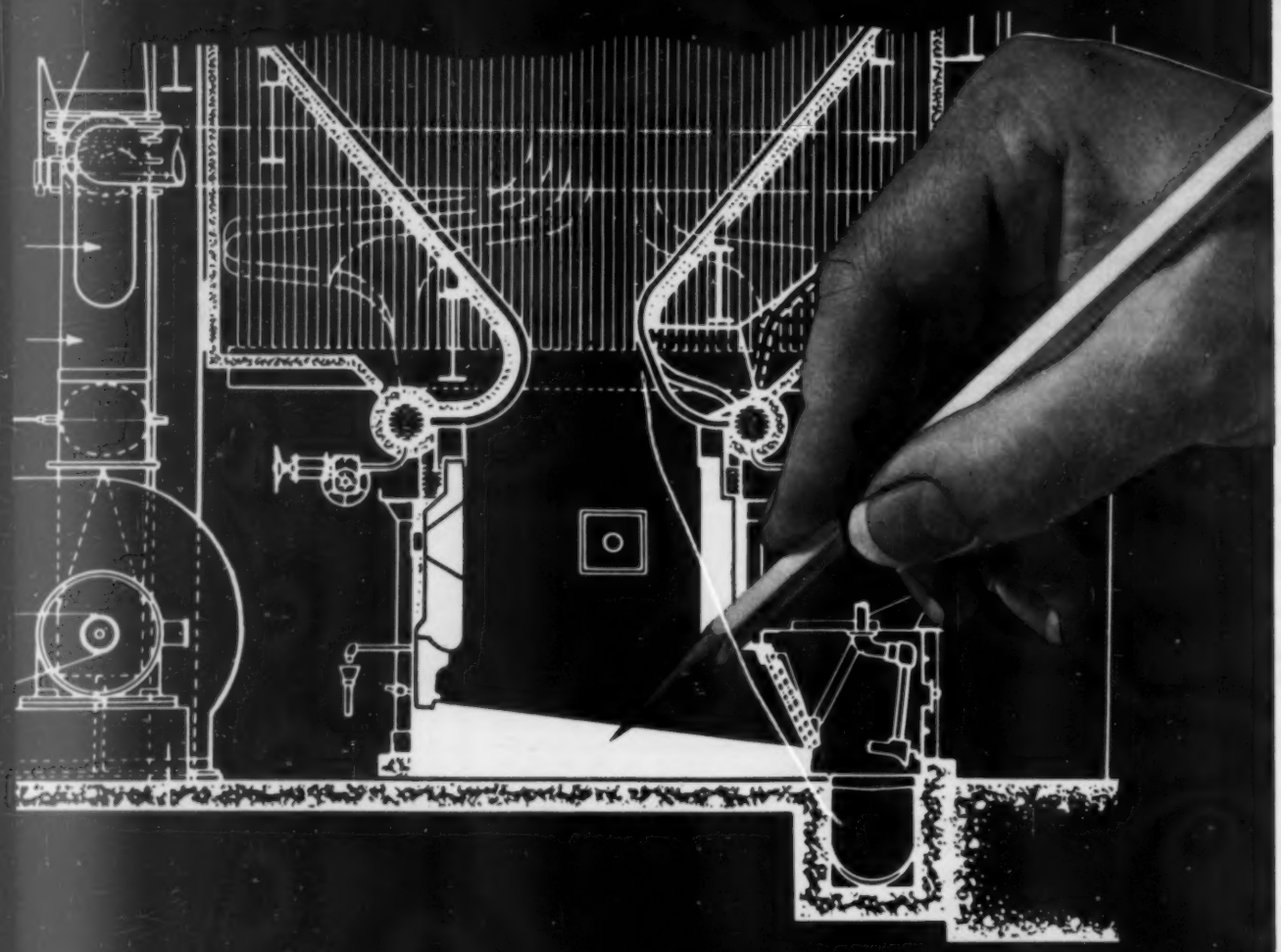
SPECIAL REFRACTORY SHAPES

Established 1912 — *Incorporated 1917*

NATIONAL AIROIL BURNER COMPANY, INC.
1391 E. Sedgley Ave., Philadelphia 34, Pa.
S. W. Division: 2512 So. Blvd., Houston 6, Texas
Circle 153 on READ-N-CIRCLE card

How to draw the line on ashpit maintenance



"Let's put Kaocrete here"

Relining ashpits is expensive and time-consuming. That's why more and more utilities and industrial companies are specifying a heavy-duty refractory castable such as B&W Kaocrete D. On job after job, it has withstood the heavy abrasive or erosive attack of sprays, jets, rakes or shovels.

The reason? Specially designed Kaocrete D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It saves time because it can be poured or gunned into place. For less severe abrasive or erosive conditions, B&W recommends Kaocrete A.

Get the facts and figures on these B&W Refractory Castables from your local B&W Refractories Engineer.

Send for Bulletin R-36 which gives data on B&W's wide line of specialized boiler refractories.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

handy guide

. . . starts on page 48

Save on rails
Read page 44 and circle number 131
L. B. Foster Co. Use Foster relayers to install and maintain rails.

Planning storage bins?
Read page 37 and circle number 132
Kalamazoo Tank and Silo Co. Storage bins, tanks, or chests for bulk materials.

MECHANICAL POWER TRANSMISSION

Get more belt use per dollar
Read page 28 and circle number 133
Raybestos-Manhattan, Inc. R/M Poly-V drive delivers more power in less space.

PIPING, TUBING AND HOSE

Custom-built flexible hose
Read page 38 and circle number 134
Cobra Metal Hose. All sizes of seamless metal hose for industrial power systems.

PUMPING EQUIPMENT

Dependable boiler feed service
Read page 2 and circle number 135
De Laval Steam Turbine Company. Two-stage horizontal split case pumps give long, economical boiler feed service.

Pioneering trouble-free pumps
Read page 56 and circle number 154
Byron Jackson. World's largest boiler feed pump proves pioneering spirit.

Solve feed pump problems
Read page 33 and circle number 136
American-Marsh Pumps. Better engineering insures you of freedom from maintenance and lubrication troubles.

No downtime with these slurry pumps
Read page 40 and circle number 137
Nagle Pumps, Inc. Nagle pumps handle slurry against 400-foot head.

Get a pump with a good reputation
Read page 26 and circle number 138
Aurora Pump Division, The New York Air Brake Company. Every Aurora pump is backed by a tradition of integrity.

REFRACTORIES AND INSULATION

Meet Bi-met furnace walls
Read page 54 and circle number 139
Bigelow-Liptak Corporation. When temperatures are high, Bimet will save cash.

Reduce ashpit maintenance
Read page 50 and circle number 140
The Babcock & Wilcox Co., Refractories Division. Relining ashpits is expensive and time-consuming, so more and more companies are specifying B&W Koacrete D.

TRAPS, STRAINERS, AND SEPERATORS

Performance guaranteed
Read page 31 and circle number 141
JAS. A. MURPHY & CO. These entirely automatic ball float traps are fully guaranteed.

VALVES AND REGULATORS

No frills on these motorized valves
Read page 25 and circle number 142
THE CHAPMAN VALVE MFG. CO. Chapman motor units are not only rugged in construction, they're simple in design.

Valves for every purpose
Read page 23 and circle number 150
CRANE CO. Valves in all sizes and metals for every application. Rapid delivery anywhere.

How are your blow-off valves?
Read page 4 and circle number 143
YARNALL-WARING COMPANY. Have you checked your blow-off valve lately? Send for free literature.

WATER SUPPLY AND TREATMENT

Low price water collection
Read page 24 and circle number 151
RANNEY METHOD WATER SUPPLIES INC. Investigate the possibilities of supplying your plant with low cost water.

Protect your plant against corrosion
Read page 52 and circle number 144
COCHRANE CORPORATION. The Cochrane salt-splitting dealkalizer is today's way of protecting against corrosion.

Hardness cut from 268 to 2 ppm
Read page 51 and circle number 145
INFILCO INC. One large plant has cut hardness from 268 to 2 ppm by using Infilco equipment, including C-A-P system.

Pioneering water conditioning
Read page 9 and circle number 146
W. H. & L. D. BETZ. New techniques in water conditioning that reduce costs, save time, and aid production are being pioneered by Betz. Send for information.

Pioneers in water treatment
Read page 36 and circle number 147
ILLINOIS WATER TREATMENT CO. Complete, practical, workable systems that operate economically.

Complete water treatment service
Read page 11 and circle number 148
THE BIRD-ARCHER COMPANY. Complete engineering services for water treatment. Write for literature.

Demineralizers built in all sizes
Read page 27 and circle number 149
HUNGERFORD & TERRY, INC. A complete line of water conditioning systems is available.

NEW JONES & LAUGHLIN WATER-TREATMENT PLANT *with* AUTOMATION *and* EQUIPMENT *by* INFILCO

cuts hardness from 268 to 2 p.p.m. —greatly reduces labor costs

The Monongahela River is the source of raw water for steam generating plants of Jones & Laughlin Steel Corporation. Total hardness ranges up to 268 p.p.m.—clarity and degree of acidity fluctuate widely.

Using a cold-process, lime-batch plant, hardness could only be reduced to about 1.5 grains per gallon, or 26 parts per million.

INFILCO equipment, including C.-A.-P. SYSTEM® instruments was chosen for greater efficiency and automatic operation. The new plant produces water averaging about 0.1 grain per gallon —2 p.p.m.—hardness. It has cut labor costs more than 50% and made better service possible. And the end result — steam production — is more efficient and economical, too.

This is another example of INFILCO leadership in this field — further proof that

Infilco knows how

to help you solve your water-treatment problems. For complete information about this interesting installation, write today for Re print No. 70 IP-11.

INFILCO INC.
General offices, Tucson, Arizona
*The **one** company offering equipment for **all** types of water and waste treatment*

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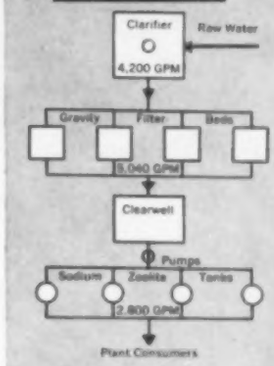
8611

FIELD OFFICES THROUGHOUT THE UNITED STATES AND FOREIGN COUNTRIES

INFILCO EQUIPMENT automatically

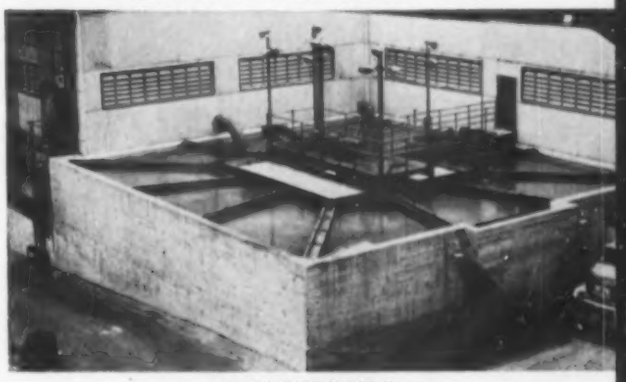


...MEASURES flow, maintains constant water level, keeps amounts of chemical proportional, removes sludge.

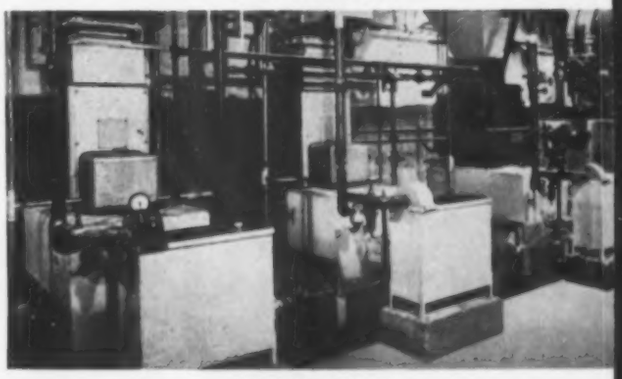
...EQUALIZES water passage by flow control and loss-of-head control, maintains same flow rate, controls backwash.

...PUMPS water to softening units and then meters it to five 175,000-lb./hr. boilers for steam generation.

MAIN PLANT COMPONENTS AND AUTOMATION



CLARIFICATION BASIN



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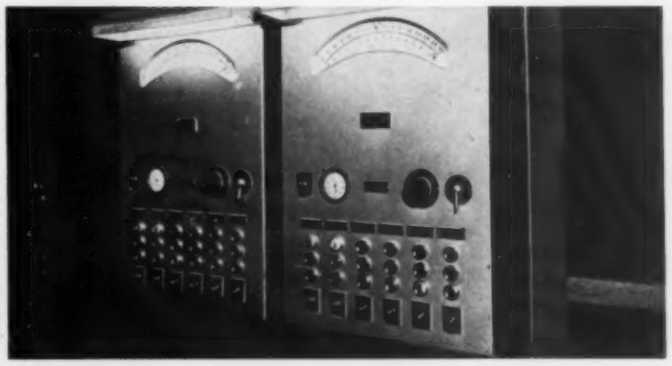
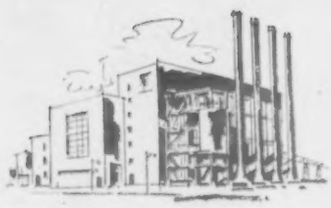


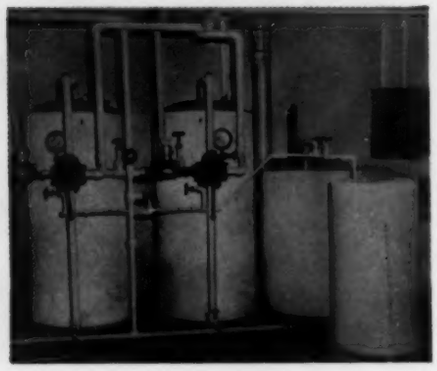
FILTER BED CONTROL PANELS

ELECTRICALLY CONTROLLED SODIUM-ZEOLITE SOFTENING UNITS

First in water conditioning

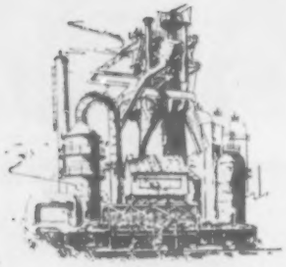
COCHRANE DEALKALIZER SAVES UP TO $2000 PER YEAR AT READING HOSPITAL. The Cochrane Dealkalizing equipment shown here eliminated huge annual piping costs by reducing CO_2 to less than 2 ppm—more than 90%!





Cochrane DEALKALIZING SYSTEM

assures **protection against corrosion**



The Cochrane Salt-Splitting Dealkalizer is the modern way to protect your condensate return line and process steam equipment against corrosion. It is also effective against carbon dioxide in the steam.

Carbon dioxide is released in the boiler by breakdown of alkalinity at high temperature. It forms carbonic acid in the condensate, resulting in a low pH which causes corrosion. Cochrane Dealkalizers reduce alkalinity of the boiler feed makeup water *without the use of acids*. They do this economically and efficiently by means of a simple ion exchange operation. The only regenerant required is common salt.

Cochrane Dealkalizers are available for all capacities and may be designed for either manual or automatic operation.

Consult Cochrane for the answer to your problem in water conditioning. They have been specialists in the field for over half a century. Write today for Bulletin 4567.

Cochrane

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American Power Conference

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the cycle chosen. This statement is not intended to discourage or deter developments for 1150-F or higher in supercritical-pressure plants. Instead, it should be recognized that there are many variables and special economic considerations related to any specific project, and each job must be analyzed on its individual merits.

"The important thing disclosed by this study is that supercritical-pressure plants can be justified for a large steam-turbine application. Economic justification of supercritical-pressure plants at 1150-F initial temperature may be possible under certain conditions. Progress demands continued research for metals suitable for such temperatures at a lower cost. The fact that natural fuels are in diminishing supply will continue to further increase fuel costs, so that it is only a matter of time before the supercritical-pressure high-temperature plant will be a justifiable economic investment."

Motor starting problems on industrial systems

H. W. Cory
Chief Engineer, Control Department
Allis-Chalmers Mfg. Co.

"Most important point of consideration in selecting the type of starting to be used is the power line stability. Low line voltage during starting of motors and during normal operation of motors is without doubt the most common and the most damaging hazard to power distribution systems. Inadequate line stability is responsible for motor overheating and burnouts, damage to controllers, unscheduled shutdowns, and light flicker. Low line voltage may be caused by overloading of transformers, insufficient capacity of transmission lines and cables, and low system power factor.

"The most important steps which can be taken to improve line voltage condition during motor starting without any changes in distribution or transmission equipment are: planned starting of motors, and proper correlation of motor starting methods and motor design type. . . .

"Nearly all that can be done to improve the voltage stability on a power system must be done on the secondary side of the transformer. Tap-changing regulators are not intended to compensate for momentary fluctuations similar to those caused by the starting of motors but maintain an average over a period of time."

good books

. . . for industry & power

Readers wanting to obtain copies of these books may order through INDUSTRY AND POWER. *Send check covering cost and we will forward your order to the publisher.*

Legal Problems in Engineering, by Melvin Nord; John Wiley & Sons, Inc.; 392 pages; $7.50.

This book is a broad, authoritative survey of those aspects of law that most concern the engineer. Text is presented in easy-to-read typography and avoids use of specific legal phrases and terminology. Thorough treatment is given to every legal subject that has any bearing on engineering. Examples and legal precedents are restricted to the minimum required to prove the point of law under consideration. This elimination of superfluous documentary examples results in condensed, timesaving reading.

Interesting commentaries are made concerning the registration of engineers with regard to past history and future requirements. This book is recommended reading for all engineers in management and those who desire to improve their understanding of the relationship and importance of legal problems to engineering.

Plant Operators' Manual, by Stephen Elonka; McGraw-Hill Book Company; 292 pages; $5.00.

This well-illustrated book shows steam engineers, plant mechanics, and other power services personnel how to maintain and operate their equipment. Text gives methods and hints to help not only in daily operation and maintenance, but also in future upgrading and license examinations. Interesting use of sequence illustrations show step-by-step procedure for many maintenance operations.

Typography is substandard, in that type size is too small for easy reading over long periods.

Text is quite thorough in its scope, covering maintenance procedures for boilers, steam engines, turbines, diesel engines, pumps, and compressors. Many topics covered may be rather fundamental for experienced personnel. Methods and procedures for using some of the latest instruments in the power field are also included.

ASME Handbook—Engineering Tables, edited by Jesse Huckert; McGraw-Hill Book Company; 704 pages; $12.00.

In this reference book, engineers and designers now have available many tables of recognized design standards not commonly found in handbooks. This practical volume makes design calculations easier and saves engineering time. It places in the engineer's hands a wealth of useful design tables to supplement his knowledge of design standards.

Handbook contains engineering data more useful to design engineers, than to engineers engaged in operation or production.

Typography is satisfactory for easy reading and illustrations consist almost entirely of line drawings, cross sections, and sketches.

COOL HEADS IN "HOT SPOTS" WON'T LET YOU DOWN

On jobs where the air is foul or hot, men can't be blamed too much for letting up now and then. If you want to keep their efficiency and morale high, feed them better air.

Employers have learned the value of putting Coppus Blowers and Ventilators on the job . . . in confined areas and near furnaces or hot processes. The men work faster, do better work, work longer without fatigue — and appreciate the more comfortable working conditions.

Give some thought now to the "hot spots" in your plant. There is a Coppus Blower for practically any requirement — Cable Manhole and Tank Ventilators, Boiler Manhole Blowers and Exhausters, Heat Killers, Shiphold Ventilators, etc. The Coppus "Blue Ribbon" is your assurance of design and construction planned for plenty of severe service. Check and mail the coupon for specific information. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

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- ☐ in tanks, tank cars, drums, etc.
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- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausters, welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME.....
COMPANY.....
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(Write here any special ventilating problem you may have.)

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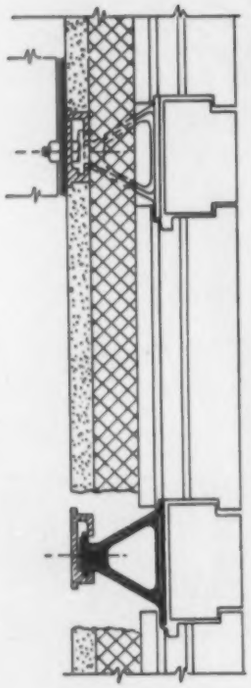
INTRODUCING
BIGELOW-LIPTAK'S
BI-MET*
Insulated Furnace Walls
For High Temperature Applications

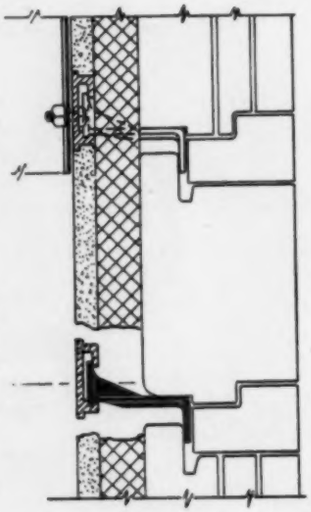


The 4½ inch wall

Here's a job-proven idea which is designed to pare the costs of suspended furnace enclosures. It's used when temperatures are going to be high and when expensive special alloy supporting castings must be used.

Two different castings are used. The first, an alloy clip casting is embedded in the tile where temperatures are highest. This, in turn, is fastened to a standard cast iron support. The design permits the most economical use of costly alloys.

This is a Bigelow-Liptak BI-MET wall and it is another example of B-L's efforts to produce quality furnace enclosures at lower and lower initial costs. Remember: a suspended enclosure for a boiler, a refinery heater, or any other type of installation, will *last longer, have less down time for repairs.* That makes a suspended job the cheapest in the long run. Want to cash in on savings like these? Contact the B-L office nearest you.



The 7 inch wall

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AND BIGELOW-LIPTAK EXPORT CORPORATION

2550 WEST GRAND BOULEVARD, DETROIT 8, MICHIGAN

UNIT-SUSPENDED WALLS AND ARCHES

In Canada: BIGELOW-LIPTAK OF CANADA, LTD., *Toronto, Ontario*

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Circle 139 on READ-N-CIRCLE card for more data

coming events

. . . for industry & power

June 17-21	ASME Semiannual Meeting	Statler Hotel Cleveland
June 25-29	AIEE Summer and Pacific General Meeting	San Francisco
Sept. 10-12	ASME Fall Meeting	Denver
Sept. 17-21	ISA 1956 Conference and Exhibit	Coliseum New York City
Sept. 25-27	Third Annual Conference Atomic Industrial Forum	Morrison Hotel Chicago
Oct. 1-5	AIEE Fall General Meeting	Morrison Hotel Chicago
Oct. 8-10	ASME Lubrication Conference	Atlantic City New Jersey
Oct. 11-12	Armour Research Foundation National Noise Abatement Symposium	Sherman Hotel Chicago
Oct. 18-19	Armour Research Foundation National Conference on Industrial Hydraulics	Sherman Hotel Chicago
Oct. 24-25	ASME Fuels Conference	Washington, D.C.
Nov. 25-30	ASME Annual Meeting and Power Show	Hotel Statler and Coliseum New York City

next month in
INDUSTRY & POWER . . . .

San Francisco plant finds key to noise control

San Francisco's North Point sewage plant has found the key to noise control in its pump room . . . reverberation control. Outstanding photograph of acoustic tile installed on pump room walls kicks off story that explains the great importance of reverberation control to effective industrial noise control.

Industry authority explains how isolation or absorption techniques have been successfully used. Whether your problem is in the powerhouse or out in the plant, you will find many clues to the best solution for your noise problems next month in the

July issue of
INDUSTRY & POWER

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Thomas C. Wilson 20

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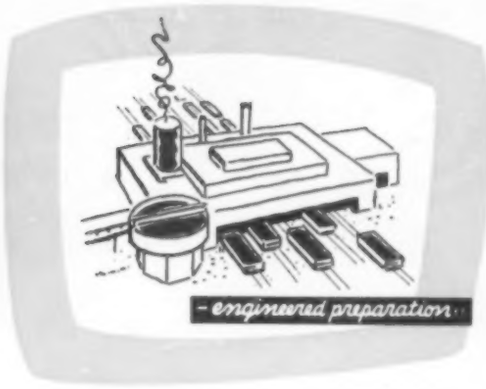
Where an * appears after a name the advertisement does not appear in this issue, but appeared in one or both of the two previous issues.

"by land and by sea"



SOUTHERN ships industrial Mid-America a tremendous yearly tonnage of high grade coals — saving important transportation dollars.

By barge through navigable inland rivers, opened up by high capacity docks on the Ohio and Green Rivers; by rail over twelve major railroads, and rail-to-water through the Great Lakes, your coal is shipped by most advantageous routes at most favorable rates.

*Southern's 27 completely mechanized mines are readily accessible. Recovery costs are low. They're located in districts noted for superior quality coal and tremendous reserves. Modern volume production techniques, and exacting methods of quality improvement and control assure uniformity, accurate application and reliable performance. Ask your nearby Southern representative how Southern's complete coal service assures you plenty of dependable fuel at substantial savings — now and for years to come.

* Famous coals from the combined operations of Southern, Sinclair and Peabody Coal companies in Eastern and Western Kentucky, Ohio, Indiana, Illinois, Iowa, Alabama, Missouri and Oklahoma.

Southern
COAL COMPANY, INC.
GENERAL OFFICE: 333 NORTH MICHIGAN AVENUE, CHICAGO 1, ILLINOIS
OFFICES IN: LOUISVILLE, MEMPHIS, MINNEAPOLIS, NASHVILLE, ST. LOUIS
SINCLAIR COAL COMPANY, KANSAS CITY 5, MO., WESTERN REPRESENTATIVE

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Byron Jackson makes history with World's Largest Boiler Feed Pump!

Byron Jackson is building the world's largest double case, high pressure boiler feed pump. According to BJ engineers, this pump will be at least twice as large as any boiler feed pump now in existence in the world. This huge unit—rated at 12,000 hp—will deliver 6,330 gallons per minute of feed water against a total dynamic head of 6,400 feet, or approximately 2,700 pounds per square inch at an operating speed of 3,510 rpm. It is being built for the Consolidated Edison Co. of New York, Inc.

A modification of the Byron Jackson-originated double case barrel type feed pump, the unit will consist of a cylindrical outer barrel and cover enclosing a horizontally-split inner volute case. The double volute design, together with back-to-back mounting of the impellers, provides for quick, uniform heating and reduces axial and radial thrust to a minimum.

UNIQUE DRIVE SYSTEM

For this BJ super pump, power company engineers are employing an altogether new concept of drive, the main generator steam turbine. Power is transmitted through an American Blower Corporation fluid drive coupling for variable speed operation to meet all load conditions.

To provide trouble-free operation, BJ engineers will incorporate packless type stuffingboxes with controlled leakage as well as a rotating element of rigid construction, limiting shaft sag to about one-third of the wear-surface clearances. Amazing as it may sound, this pump could be run dry.

ANOTHER BYRON JACKSON "FIRST"

This pump represents one more pioneering step undertaken by Byron Jackson in its long history of designing rugged, trouble-free pumps for any service.

BJ

Byron Jackson

Division of Borg-Warner Corporation
P. O. Box 2017A, Terminal Annex
Los Angeles 54, California

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BYRON JACKSON
Division of Borg-Warner Corporation
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Phoenix
2630 E. Washington
Tel. BRidge 5-5729

ARKANSAS
West Memphis
1621 E. Broadway
Tel. 2158
(or Memphis, Tenn.
Tel. 5-6064)

CALIFORNIA
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Butte Pump & Motor Works
944 Broadway
Tel. FIreside 2-3651
Fresno 3
356 N. "H" Street
Tel. 4-5938
Lodi
500 E. Kettleman Lane
Tel. 8-0471
Los Angeles 58
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Tel. Gilbert 3-1819
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San Jose
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Tel. SHerwood 2-3263

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New Orleans 12
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Kansas City 6
1207 Grand Avenue
Tel. Victor 8071
St. Louis 1
812 Olive Street
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North Platte
1111 E. 6th Street
Tel. 653

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New York 36
500 Fifth Avenue, Room 510
Tel. PLaza 7-0400

OHIO
Cleveland 14
716 Society for Savings Bldg.
Tel. SUperior 1-5287

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Tel. LUther 7-6675

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741 E. Ettwein Street
Tel. UNiversity 4-8521
Philadelphia 2
Lewis Tower Bldg.
Tel. PEnnypacker 5-1681
Pittsburgh 19
429 Fourth Avenue
Tel. EXpress 1-0462

SOUTH CAROLINA
Greenville
314 E. Coffee Street
Tel. 5-7820

TEXAS
Beaumont
480 Orleans St., Room 513
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Corpus Christi
925 Jones Building
Tel. TUlip 4-7841
Dallas 1
814 Gibraltar Life Bldg.
Tel. RIverside 4067
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6247 Navigation Boulevard
Tel. WAlnut 6-8321
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2201 Fourth Street
Tel. POrter 3-0493
Plainview
1305 N. Columbia Street
Tel. CApitol 4-5505

WASHINGTON
Seattle 1
314 Lloyd Building
Tel. MUtual 2558

WASHINGTON 5, D. C.
730 - 15th Street, N.W.
Tel. District 7-2456

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Montreal 18, Quebec
Byron Jackson of Canada Ltd.
3414 Park Avenue
Suite 305
Tel. AVenue 8-5144
Toronto 13, Ontario
Byron Jackson of Canada Ltd.
P.O. Box 180, Station "H"
Tel. PLymouth 5-1196

MEXICO
Mexico City 1, D. F.
Byron Jackson Co., S. A.
P. O. No. 21125
Plaza de la Republica 9-186
Tel. 21-49-41